MAY 11 1926

Printed on Thin Paper for Foreign Circulation.

"THE ENGINEER" APRIL 30, 1926.

With METALLURGICAL SUPPLEMENT.

The Engineer.

Established 1856.

Registered as a Newspaper.

OFFICE FOR ADVERTISEMENTS & PUBLICATION, 33, NORFOLK ST., STRAND, LONDON, W.C. 2.

VOL. CXLI.—No. 3670] LONDON: FRIDAY EVENING, APRIL 30, 1926 [PRICE {WITH SUPPLEMENT} ONE SHILLING BY INLAND POST 1s. 3d.

PUBLIC NOTICES

The Director-General, India Store Department, Branch No. 15, Belvedere-road, Lambeth, S.E. 1, invites TENDERS for :—

1. SCREW COUPLINGS.
2. LAMINATED BEARING SPRINGS.
3. HELICAL and VOLUTE SPRINGS.
4. WHEELS and AXLES.
5. ROLLED STEEL JOISTS.
6. ELECTRICALLY DRIVEN MONORAIL WALKING CRANES, 13ft. radius, 4-ton capacity.
7. GALVANISED TUBING and FITTINGS for WATER.
8. PRESSED STEEL BOGIES with WHEELS and AXLES for RAILWAY CARRIAGES.
9. AXLE-BOXES for CARRIAGES and WAGONS.
10. STEEL AXLES for CARRIAGES and WAGONS.
11. LOCOMOTIVE BOILERS.

Tenders due on the 11th May, 1926, for Nos. 1, 2, 3, 4, and 5; on the 18th May, 1926, for No. 6; on the 21st May, 1926, for Nos. 7, 8, 9, and 10; and on the 26th May, 1926, for No. 11.

Tender forms obtainable from the above. 2307

Assistant Engineers (3) REQUIRED for the NIGERIAN GOVERNMENT RAILWAY (Construction) for a tour of 12 to 18 months, with possible extension. Free passages and a commuted bush and travelling allowance of £9 a month whilst on duty in the Colony. Camp equipment provided. Outfit allowance of £60 on first appointment. Liberal leave on full salary. Salary £480 for the first three years of service, then £510, rising to £720 a year by annual increments of £30, and thence rising to £920 a year by annual increments of £40. Candidates must have passed examination to qualify for A.M.I.C.E. or hold equivalent professional qualifications and possess experience on Railway Location.—Apply at once by letter, stating age, qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, London, S.W. 1, clearly quoting M/14185. 2261

Assistant Engineers (8) REQUIRED for the PUBLIC WORKS DEPARTMENT of the FEDERATED MALAY STATES for four years' service. Salary 400 dollars a month, rising to 800 dollars by annual increments of 25 dollars, plus a temporary non-pensionable allowance of 10 per cent. for bachelors and 20 per cent. for married men. The exchange value of the dollar in sterling is at present fixed by the Government at 2s. 4d., but its purchasing power in Malaya is considerably less than that of 2s. 4d. in the United Kingdom. No income tax at present imposed by the Federated Malay States Government. Free passages provided. Candidates, age 23 to 26, preferably unmarried, must have received a good theoretical training, preferably at a University or College recognised by the Institution of Civil Engineers and possess a Civil Engineering Degree or obtained such other diplomas or distinction in engineering as the Secretary of State may decide in any particular case, or have completed articles with a Civil Engineer of good standing and have passed the examination for Associate Membership of the Institution of Civil Engineers. In addition, candidates must have had at least one year's practical experience of civil engineering under a qualified civil engineer.—Apply at once by letter, giving brief details of qualifications and experience and stating age and whether married or single, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, S.W. 1, quoting clearly at head of application M/14579. 2326

Civil Engineer Required by the GOVERNMENT of TANGANYIKA TERRITORY for the PUBLIC WORKS DEPARTMENT (Harbour Works) for tour of 20 to 30 months' service, with possible extension. Salary £660, rising to £800 a year by annual increments of £25, plus a temporary allowance, at present authorised up to the 30th of June, when its continuance or otherwise will be subject to review, amounting on a salary of £500 a year to £90 a year. Free quarters and passage and liberal leave on full salary. Outfit allowance of £30 on first appointment. Candidates, aged 28 to 45, must have passed the examination for Associate Membership of the Institution of Civil Engineers and have had practical experience of Harbour Works and Marine Surveying.—Apply at once by letter, stating age, qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting M/14492. 2322

Civil Engineers (2) Required by the RAILWAY DEPARTMENT of the TANGANYIKA TERRITORY for a tour of 20 to 30 months' service, with possible extension. Salary £400, rising to £600 a year, plus a temporary allowance of 20 per cent., at present authorised up to the 30th of June, when it will be subject to review. Outfit allowance of £30 on first appointment. Free quarters and passages and liberal leave on full salary. Candidates, aged 23 to 40, must be fully qualified Railway Engineers, who have had good training and experience on recognised European, American or Colonial Railways. Candidates who are A.M. Inst. C.E. preferred. —Apply at once by letter, stating age, qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, London, S.W. 1, quoting M/14544. 2298

Royal Corps of Naval Constructors. A COMPETITIVE EXAMINATION for a POST of PROBATIONARY ASSISTANT CONSTRUCTOR will be held at the Royal Naval College, Greenwich, in June next.

The Regulations and full particulars of the salary, &c., may be obtained from the SECRETARY of the ADMIRALTY (C.E. Branch), Whitehall, S.W. 1, to whom intending candidates must submit their names and full particulars of their educational and technical training and practical experience not later than the 12th May next.

Candidates must be not more than 24 years of age on the 1st October next.

PRIVATE STUDENTS OF NAVAL ARCHITECTURE.

In conjunction with the above Examination there will be a QUALIFYING EXAMINATION for the admission of PRIVATE STUDENTS of NAVAL ARCHITECTURE to the Royal Naval College, Greenwich.

Applications for the Regulations, &c., should be made as in the case of the Examination for the post of Probationary Assistant Constructor (see above).

Private Students are required to pay a fee of £50 a Session whilst at the College. 2263

The Engineer

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PUBLIC NOTICES

Civil Engineers Required by the GOVERNMENT of the GOLD COAST for the PUBLIC WORKS DEPARTMENT for two tours of 18 months, with possible extension. Salary £480 for the first three years of service and then £510, rising to £920 a year. Outfit allowance of £60 on first appointment. Free passages and quarters and liberal leave on full salary. Candidates, aged 25 to 35, must have received a good technical education and a regular training as Civil Engineers, and have had a practical knowledge of surveying, levelling, quantities, estimates, reinforced concrete work and civil engineering generally, including construction.—Apply at once by letter, stating age, qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, London, S.W. 1, quoting M/14531. 2280

Electrically Driven PUMPING SET, consisting of 24 H.P. Siemens Motor, 440 volts continuous current, 1440/1650 r.p.m., direct coupled to Holden and Brooke Centrifugal Four-stage Pump, 800 galls. p.m. against 150ft. head. Control gear, including automatic releases and speed regulator.

All in very good condition.

Applications for forms of Tender should reach the SUPERINTENDING ENGINEER, N.W. District, W. and E. Dept., R.A.F. Depot, Uxbridge, Middlesex, not later than 14th May, 1926. 2262

City of Leicester.

TENDERS are INVITED for the SUPPLY and DELIVERY of 175 TONS of B.S. No. 7 SECTION STEEL GIRDER TRAMWAY RAILS, together with the necessary FISH-PLATES, all of which must comply with the British Engineering Standards Association Specification.

Form of Tender, &c., may be obtained from the office of the City Surveyor, Town Hall, Leicester, on payment of the sum of One Guinea, which will be returned on receipt of a bona fide Tender. Cheques to be made payable to the Leicester Corporation Tramways.

Sealed and endorsed Tenders, addressed to "The Chairman of the Tramways Committee, Town Hall, Leicester," must be delivered not later than 10th May, 1926.

The Council do not bind themselves to accept the lowest or any Tender.

H. A. PRITCHARD, Town Clerk.

Town Hall, Leicester, 23rd April, 1926. 2274

PUBLIC NOTICES

Bradford Education Committee.

TECHNICAL COLLEGE.

APPLICATIONS are INVITED for APPOINTMENT as HEAD of the DEPARTMENT of MECHANICAL ENGINEERING in the College.

The scale of salary attached to this appointment will be £600 to £700 per annum.

Full particulars of the appointment and forms of application may be obtained from the Director of Education, Town Hall, Bradford, and the completed applications should be returned to the Principal of the College not later than 10th May, 1926.

2312 N. L. FLEMING, Town Clerk.

Brighton Technical College.

Principal: W. MANSERGH VARLEY, M.A., D.Sc., Ph.D., F.C.S.

ASSISTANT LECTURER IN MECHANICAL ENGINEERING.

APPLICATIONS INVITED from Graduates in Engineering. At least three years' works and drawing-office experience essential. Burnham Scale salary, with allowances for works experience, &c. Appointment to date from 1st September. Forms of application from the undersigned, returnable not later than 28th May.

F. HERBERT TOYNE, Secretary.

Education Offices, Old Steine, Brighton. 2281

City of Nottingham.

NORTH WILFORD POWER STATION.
EXTENSION NO. 1.—CONTRACT NO. 11.
TO BUILDERS AND CONTRACTORS.

The Electricity Committee is prepared to receive TENDERS for the ERECTION of BUILDINGS in connection with Extension No. 1 of this station.

Drawings may be seen and copies of the general conditions of contract, specification, bill of quantities, and form of Tender may be obtained on application to Mr. T. Wallis Gordon, City Engineer and Surveyor, Guildhall, Nottingham, on payment of a deposit of Two Pounds, which will be returned on receipt of a bona fide Tender.

Sealed Tenders are to be delivered to the undersigned in the official envelope provided not later than 9 a.m. on Thursday, 20th May, 1926.

The lowest or any Tender will not necessarily be accepted, and Tenders will only be accepted from firms who conform to the conditions of the contract as regards paying the local standard rate of wages, &c., and to the working rules of the Nottingham district.

By Order, W. J. BOARD, Town Clerk.

Guildhall, Nottingham, 26th April, 1926. 2277

PUBLIC NOTICES

City of Nottingham.

WATER DEPARTMENT.
PUMPING PLANT—BURTON JOYCE.

The Water Committee invite TENDERS from competent contractors for the MANUFACTURE, SUPPLY, ERECTION and SETTING to WORK complete ELECTRICALLY DRIVEN MULTI-STAGE CENTRIFUGAL PUMPS (capacity 2 million gallons per 24 hours), ELECTRIC MOTORS, and other APPURTENANT WORK.

General conditions, specification, schedules and form of Tender may be obtained from Mr. F. W. Davies, Engineer and General Manager, Water Offices, Castle Boulevard, Nottingham, on payment of a deposit of £5 5s., which will be refunded on receipt of a bona fide Tender, not afterwards withdrawn, and the return of all documents.

Tenders must be endorsed "Tender for Pumping Plant at Burton Joyce" and reach the undersigned not later than Noon on Friday, the 21st day of May, 1926.

The Committee do not bind themselves to accept the lowest or any Tender.

W. J. BOARD, Town Clerk.

Guildhall, Nottingham, 20th April, 1926. 2272

City of Nottingham.

NORTH WILFORD POWER STATION.
EXTENSION NO. 1.—CONTRACT NO. 12.
TO STRUCTURAL ENGINEERS.

The Electricity Committee is prepared to receive TENDERS for about :—

420 TONS of STEEL WORK in Stanchions, Girders, Beams, Roof Trusses, &c.

2 TONS of CAST IRON in Gutters, Standards, &c., required in connection with the construction of the above.

Drawings may be seen and copies of the general conditions of contract, specification, bill of quantities, and form of Tender, &c., may be obtained on and after Monday, 3rd May, 1926, on application to Mr. T. Wallis Gordon, City Engineer and Surveyor, Guildhall, Nottingham, on payment of a deposit of Two Pounds, which will be returned on receipt of a bona fide Tender.

Sealed Tenders, duly stating the time required for the completion of the work, are to be delivered in the official envelope provided to the undersigned not later than 9 a.m. on Thursday, 20th May, 1926.

The lowest or any Tender will not necessarily be accepted, and Tenders will only be accepted from firms who conform to the conditions of the contract as regards paying the local standard rate of wages, &c., and to the working rules of the Nottingham district.

By Order, W. J. BOARD, Town Clerk.

Guildhall, Nottingham, 26th April, 1926. 2276

City and County of Kingston-upon-Hull.
ELECTRICITY DEPARTMENT.

The Electricity Committee of the Hull Corporation invite TENDERS for :—

STEEL WORK SUB-STRUCTURE FOR SCULCOATES SUB-STATION.

Tender forms, general conditions and specification can be obtained on payment of £1 1s. to the City Treasurer, Guildhall, Hull, such deposit being returnable on receipt of a bona fide Tender.

The Corporation does not bind itself to accept the lowest or any Tender.

Tenders, addressed "Chairman, Electricity Committee, Guildhall, Hull," and endorsed "Tender for Sub-station Steel Work," should be delivered by Noon on Thursday, May 20th, 1926.

H. BELL, M.I.E.E., City Electrical Engineer and Manager.

Electricity Works, Sculcoates, Hull. 2310

The County of London Electric SUPPLY CO., LTD.
BARKING POWER STATION EXTENSIONS, 1926.

The County of London Electric Supply Co., Ltd., are prepared to receive TENDERS for EXCAVATION WORK and CASTING and DRIVING of approximately 1800 REINFORCED CONCRETE PILES, 14in. by 14in., varying from 25ft. to 40ft. long, in connection with the extensions to the Power Station at Barking.

The specification, schedule and form of Tender can be obtained from Sir Alexander Gibb and Partners, Queen Anne's Lodge, Westminster, London, S.W. 1.

A deposit of £5 5s. will be charged for the documents, and this will be returned on receipt of a bona fide Tender by the date below mentioned.

Sealed Tenders, endorsed "Tender for Piling," must be delivered to the undersigned not later than Noon on Monday, 10th May, 1926.

The Company do not bind themselves to accept the lowest or any Tender.

F. C. McQUOWN, Joint Manager and Secretary.

County of London Electric Supply Co., Ltd., Moorgate-court, Moorgate-place, London, E.C. 2. 2276

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PUBLIC NOTICES

Rochester and Chatham Joint
SEWERAGE BOARD.
MAIN OUTFALL SEWER AND DISPOSAL WORKS.
CONTRACT NO. 4.

The Board is prepared to receive TENDERS for the COMPLETION of the CONSTRUCTION of the MAIN OUTFALL SEWER, consisting of Laying about 3194 Yards of 36in., 33in., and 32in. Cast Iron Pipes in double pipe lines; and the Construction of about 241 Yards of Concrete Sewer Culvert, size 5ft. 3in. high by 3ft. 6in. wide, together with appurtenant works. Also for the CONSTRUCTION of NEW SEWAGE DISPOSAL WORKS, comprising Grit Tanks, Screens, Sewage Carriers, Storm Tanks, Settling Tanks, Sludge Drying Beds, Power-house, Pump-house, Offices, and all appurtenant Works at Motney Hill, near Rainham, Kent.

Also for LAYING about 924 Yards Lineal of 24in., 36in., and 42in. CAST IRON PIPES on the site, and 494 Yards Lineal of 36in. and 42in. CAST IRON TIDAL OUTFALL PIPES on WOOD PILING.

The works are part of the Board's scheme of sewerage which is approved for grant by the Unemployment Grants Committee, and that Committee has laid down as a condition that all contracts for or incidental to the works are to be placed in this country.

The Board will require that all goods and materials supplied shall be of British production and manufacture.

Plans may be seen and quantities and form of Tender obtained on and after the 19th April at the office of the Engineers, Messrs. W. H. Radford and Son, Chartered Civil Engineers, Albion Chambers King-street, Nottingham, and also at my office, as under, on deposit of Ten Guineas (cheque), which will be returned on receipt of a bona fide Tender and the return of the quantities, &c.

Sealed Tenders, endorsed "Contract No. 4—Disposal Works," to be delivered to me at my office, as under, on or before the 29th May, 1926.

The Board does not bind itself to accept the lowest or any Tender.

By Order,
R. W. WATKINS,
Clerk to the Board.

13, New-road, Chatham Kent,
April 12th, 1926. 2144

Rochester and Chatham Joint
SEWERAGE BOARD.
MAIN OUTFALL SEWER AND DISPOSAL WORKS.
CONTRACT NO. 5.
TO IRONFOUNDERS.

The Board is prepared to receive TENDERS direct from ironfounders for the SUPPLY and DELIVERY at Rainham Station, near Chatham, Kent, of about 2530 TONS of CAST IRON PIPES and SPECIALS.

The Pipes and Specials will be 42in., 36in., 33in., 32in., 24in., 18in., 12in., 9in., 6in., and 3in. diameters, and will be mostly British Standard Spigot and Socket Class.

The Pipes and Specials are required in connection with the Board's scheme of sewerage and sewage disposal, which is approved for grant by the Unemployment Grants Committee, and that Committee has laid down as a condition that all contracts for or incidental to the works are to be placed in Great Britain.

The Board will require that all goods shall be of British production and manufacture.

Quantities, form of Tender, specification and conditions of contract may be obtained on and after the 19th April from the office of the Engineers, Messrs. W. H. Radford and Son, Chartered Civil Engineers, Albion Chambers, King-street, Nottingham, on deposit of Three Guineas (cheque), which sum will be returned on receipt of a bona fide Tender and the return of the quantities, &c.

Sealed Tenders, endorsed "Contract No. 5—Ironwork," to be delivered to me at my office, as under, on or before the 29th May, 1926.

The Board does not bind itself to accept the lowest or any Tender.

By Order,
R. W. WATKINS,
Clerk to the Board.

13, New-road, Chatham, Kent,
April 12th, 1926. 2145

Scarborough Corporation.
NEW IRTON WATER SCHEME.
CONTRACT NO. 6.
PIPE LAYING.

The Corporation invite TENDERS from experienced contractors for the LAYING of about 4 MILES of 15in. and 13in. CAST IRON PIPES and SPECIALS and SHORT LENGTHS of SMALLER PIPES, together with VALVES, HYDRANTS, METERS, &c. The pipes will be supplied by the Corporation.

The work will extend from the Irton Pumping Station of the Corporation to the New Service Reservoir at Spring Hill, Scarborough, Yorkshire.

Copies of the specification and form of Tender prepared by the Engineer, Dr. H. Lapworth, M. Inst. C.E., 25, Victoria-street, Westminster, may be obtained on application to the undersigned on or after Monday, the 3rd May. The application must be accompanied by the sum of £3, which will be refunded on return of the documents within seven days or after the receipt of a bona fide Tender and the documents required.

Tenders are to be sent in on the form supplied, and with the specification must be enclosed in a sealed cover endorsed "New Irton Water Scheme: Tender for Pipe Laying: Contract No. 6," and addressed to the undersigned, reaching him not later than 10 a.m. on Wednesday, May 26th, 1926.

Copies of the contract drawings may be inspected at the Town Hall on application to Mr. H. Richardson, Water Engineer, Water Department, Town Hall, Scarborough, and general information regarding the route of the pipe line from Mr. M. B. Mawson, Resident Engineer.

The Corporation do not bind themselves to accept the lowest or any Tender, and the acceptance of any Tender is subject to the sanction of the Ministry of Health to the loan for carrying out the scheme.

SYDNEY JONES,
Town Clerk.

Town Hall, Scarborough,
22nd April, 1926. 2273

Surrey County Council.
HIGHWAYS AND BRIDGES DEPT.

APPLICATIONS are INVITED for the APPOINTMENT of a TEMPORARY ENGINEERING ASSISTANT at a salary of £6 6s. per week.

The probable duration of the appointment will be not less than 12 months, subject to satisfactory service.

The appointment will be terminable by a month's notice on either side, and will not be subject to the provisions of the Local Government Officers Superannuation Act, 1922.

Applicants should be competent to make surveys, take levels, and assist in the preparation of specifications and bill of quantities, and preference will be given to candidates with knowledge of the design of bridges in reinforced concrete and who are Associate Members of the Institution of Civil Engineers or hold the Testamur of the Institution of Municipal and County Engineers.

Applications, in writing, must reach the undersigned not later than Friday, 7th May, 1926.

W. P. ROBINSON, A.M. Inst. C.E.,
County Surveyor.

County Hall Annexe,
Kingston-on-Thames,
22nd April, 1926. 2271

MACHINERY, &c., WANTED

WANTED, a 1000-Ton TOGGLE PRESS, Suitable for embossing steel plates. Stroke not less than 3in.—Address, "PRESS," Wm. Porteous and Co., Advertising Agents, Glasgow. P1858 F

WANTED, Small or Medium-size Fearns-Richards or Kearns BORING FACING MACHINE. State price, condition, and where seen.—Address, 2280, The Engineer Office. 2280 F

2 CWT. FLUE WELDING STEAM HAMMER, Massey or other approved make.—Address full particulars and price, 2314, The Engineer Office. 2314 F

PUBLIC NOTICES

The Borough of Portsmouth
WATERWORKS COMPANY.
APPOINTMENT OF ASSISTANT ENGINEER TO THE COMPANY.

APPLICATIONS are INVITED for the APPOINTMENT, now vacant, of ASSISTANT ENGINEER to the Company. Candidates should be between 35 and 40 years of age and Corporate Members of the Institution of Civil Engineers would have preference.

Applications will be considered only from those who have had a full training (theoretical and practical) and a first-class experience in the design, construction, maintenance, and administration of waterworks. Knowledge of pumping machinery would also be advantageous. Commencing salary £500 per annum, rising by annual instalments of £25 to £650, less 5 per cent. obligatory contribution to the Company's Superannuation Fund.

The appointment is subject to the selected candidate satisfactorily passing an examination by the Company's Medical Officer, and may be determined after three months' notice on either side. Application should be made only on the forms which will be provided on request by the ENGINEER, Waterworks Offices, Commercial-road, Portsmouth, and must be delivered at that address not later than Friday, 28th May, 1926. 2275

SITUATIONS OPEN

COPIES OF TESTIMONIALS, NOT ORIGINALS, UNLESS SPECIFICALLY REQUESTED.

WANTED, a Young ENGINEER for the London office of a Firm of Engineers manufacturing Pumps, Compressors, &c. Some commercial experience, good practical and theoretical training essential.—Address, stating experience and salary required, 2292, The Engineer Office. 2292 A

WANTED, Young Energetic ENGINEER (Technical School man preferred) as PRODUCTION MAN for large Engineering Works near Manchester. Must have good up-to-date workshop experience of manufacture of small accurate parts. State experience, technical training, age, and wages required.—Address, 2315, The Engineer Office. 2315 A

ASSISTANT ESTIMATOR, with Experience of trade. State age, experience, and salary required.—H. and T. DANKS (NETHERTON), Ltd., Boilermakers, Netherton, Dudley. 2313 A

CIVIL ENGINEER, Single, REQUIRED for Railway Surveys and Construction in Brazil; 2 years' engagement; salary £480 per annum, free passages, quarters and outfit allowance. Experience railway surveys and construction essential and knowledge of Portuguese or Spanish.—Write, Box 42, c/o Judd's, 47, Gresham-street, E.C. 2. 2296 A

CONSULTING ENGINEER and MANUFACTURER has an OPENING in his London Office for a PREMIUM PUPIL. Must have a good general education, some knowledge of drawing an advantage. Would be given a thorough training with a view to a permanent post when proficient. Interview by appointment.—Address, 1936, The Engineer Office. 1936 A

ENGINEER REPRESENTATIVE REQUIRED for Glasgow district by firm manufacturing Pneumatic Tools; must have sound technical and practical experience of tools and plant, and one who has been in constant touch with users of such.—Address in the first instance, stating experience, salary required, ground covered, age, and enclose copies of recent testimonials, 2299, The Engineer Office. 2299 A

FACTORY SUPERINTENDENT REQUIRED by a Firm of Electrical Engineers, to Take Charge, under Works Manager, of the Switchboard Department employing about 1000 men. Must be energetic and have good organising abilities.—Address, giving full details of experience and qualifications, &c., 2233, The Engineer Office. 2233 A

INDIA.—REQUIRED IMMEDIATELY, SHIPYARD DRAUGHTSMAN, experienced in design and lines of Shallow-draught and River Craft. Age about 25 years and single.—Write, with details of experience and copies of testimonials, to "Z.Y. 795," c/o Deacon's, Fenchurch-avenue, London, E.C. 3. 2316 A

LARGE ENGINEERING FIRM DESIRE to OBTAIN SERVICES (either whole or part time) of experienced MAN for Dust Collecting Systems.—Address, stating age, experience, and salary required, P1874, The Engineer Office. P1874 A

PRODUCTION MANAGER WANTED by Established Firm of Engineers in Yorkshire, to examine costs of production by existing methods and machines and suggest improved methods. Only practical men who have held similar positions need apply. State age, experience, and salary required, with copies of testimonials.—Address, 2291, The Engineer Office. 2291 A

REQUIRED for Mine in British Guiana, Capable FITTER-TURNER as Foreman for Repair Department; good general experience essential, age 30-35; commencing salary £450-£500; three years' agreement.—Address, with full particulars of experience, 2279, The Engineer Office. 2279 A

SALES ENGINEER REQD., London; Exp. Oil Fuel Burners ess. Also at least 3 years' recent sales exp. Good opening. Sal. to start £400 plus commission.—Apply, LAURIE'S, Employment Specialists, 28, Basinghall-street, E.C. 2. No preliminary fee. 2320 A

SALES MANAGER.—WANTED by Large Firm of Structural Engineers for service in Bombay, a fully qualified SALES MANAGER. Drawing-office and field experience essential. Public school man, age 35-40, preferred.—Address, giving full particulars and stating salary required, 2288, The Engineer Office. 2288 A

STRUCTURAL FIRM in Scotland REQUIRE the SERVICE of OUTSIDE REPRESENTATIVE to solicit enquiries and orders. One with experience of the markets (home and exports) for Steel-framed Buildings essential. Salary and commission.—Address, "STRUCTURAL," Wm. Porteous and Co., Advertising Agents, Glasgow. P1864 A

YOUNG ENGINEER ASSISTANT for Waterworks near London. Must be competent draughtsman and possess good theoretical and practical acquaintance of Machinery. Knowledge of Chemistry preferred.—Address, giving qualifications, age, and salary required, 2284, The Engineer Office. 2284 A

WANTED by an Old-established Firm of Machine Tool Makers, a first-class DESIGNER, with a practical knowledge of Medium and Heavy Type Machine Tools and capable of Taking Sole Responsibility of Designing; must be good Mathematician and able to organise and control drawing-office staff.—Address, giving full particulars of experience and salary expected, 2325, The Engineer Office. 2325 A

WANTED, CHIEF DRAUGHTSMAN for a Large Bridge Building and Constructional Steel Works. Must be capable of taking complete charge; heavy important contracts now running.—Reply by letter, giving full particulars of experience, age, when at liberty, and salary required, 2285, The Engineer Office. 2285 A

WANTED, Good SENIOR DESIGNING DRAUGHTSMAN IMMEDIATELY. Aircraft experience essential; knowledge of Stress Work desirable.—Reply, stating age, salary, and when free, to WESTLAND AIRCRAFT WORKS, Yeovil. 2290 A

WANTED, LEADING DRAUGHTSMAN and ASSISTANT DRAUGHTSMAN.—Apply, stating age, salary required, and qualifications, to HEENAN and FROUDE, Ltd., Structural Engineers, Newton Heath, Manchester. 2287 A

SITUATIONS OPEN (continued)

COACHWORK DRAUGHTSMAN REQUIRED, Able to set out specifications and estimates, by Firm of Commercial Chassis Builders. Particulars of age, experience, and salary required.—Address, 2212, The Engineer Office. 2212 A

DRAUGHTSMAN (Engineering) WANTED for Northern Peru. Three years' contract.—Reply, stating age, experience, and salary required, also if any knowledge of Spanish, to Box 537, Leathwait and Simmons, 34, Throgmorton-street, E.C. 2. P1850 A

DRAUGHTSMEN REQUIRED, Experienced in the Design of and Detail Drawings for Constructional Steelwork, General Civil Engineering and Reinforced Concrete. Only applicants who have recently been engaged in this class of work will be considered. Applications must state age, salary required, full particulars of training and experience and the earliest date on which work could be commenced.—A. H., Box 2224, Willings, 30, King-street, W.C. 2. 2324 A

DRAUGHTSMAN WANTED, Thoroughly Experienced in detailing Mechanical and Structural Work for Conveyor Plants, &c. State age, salary required, and experience.—Address, 2300, The Engineer Office. 2300 A

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For continuation of Small Advertisements see page 3.

A Seven-Day Journal

The White Star Line.

As an outcome of negotiations which, we understand, are now only in the preliminary stages, it seems likely that the Oceanic Steam Navigation Company, Ltd. (White Star Line) will shortly revert to British financial control. According to a joint official statement which was issued on Monday evening last by Messrs. Morgan, Grenfell and Co. and Mr. P. A. S. Franklin, the president of the International Mercantile Marine Company, provisional agreement has been reached for the taking over of the shares of the White Star Company by a British group. Naturally numerous details require to be arranged, and some time will elapse before a final announcement can be made. It has been stated, however, that if the negotiations mature it will be found that Furness, Withy and Co., Ltd., will be the principal shipping firm in the purchasing syndicate. The shares of the Oceanic Steam Navigation Company (White Star Line) are now held by the International Navigation Company, Ltd., which is controlled by the International Mercantile Marine Company, of New Jersey. The fleet of the White Star Line comprises some twenty-four liners, including the Majestic, Olympic, Homeric, and other famous vessels, which are engaged in the North Atlantic, Australian, and New Zealand trades. The company has, moreover, a controlling interest in George Thompson and Co., Ltd., who manage the five liners of the Aberdeen Line.

Television.

ACCORDING to Mr. John Baird, the inventor of the "Televisor," the problem of television has been solved. At a recent demonstration the results obtained with Mr. Baird's apparatus proved to be far superior to those that were secured three months ago. A member of the daily Press who stood at the transmitter was easily recognised by his colleagues at the receiving end, and when he spoke into a telephone connected to a loud speaker near the televisor receiver his lips could be seen pronouncing each word. The inventor believes that in a short time it will be possible to see a football match 200 miles away from the field. Friendly negotiations are said to be taking place between Mr. Baird and the British Broadcasting Company with a view to co-operation, but we scarcely think that the public can look forward to seeing football matches, &c., in its homes in the near future. There seems to be little doubt, however, that sooner or later demonstrations of this nature will be given in places of amusement. For many years scientific investigators have had this matter under consideration, and in our issue of April 11th, 1924, we published a lecture by Mr. Campbell Swinton on this fascinating subject. Mr. Swinton described in detail several schemes that had been proposed, and also a method of his own, which, however, has never, so far as we are aware, been put to the test of practical application.

The Smoke Abatement Bill.

THE manufacturers of Sheffield have for long contended that the production of a certain quantity of smoke is essential to the success of some of the processes which they carry on, and that a too rigid enforcement of smoke abatement regulations would seriously react on the quality of their wares. It is therefore a little surprising to find that Mr. W. Nicholson, Chief Smoke Inspector for the city of Sheffield, is an active critic of the Smoke Abatement Bill now before Parliament, on the ground that it unnecessarily exempts from the observance of its requirements certain sources of smoke, among which are included heating and other equipment of a kind largely used in many Sheffield establishments. The Bill continues to exempt the domestic fire, chimneys belonging to the Government, ships, vessels and boats, and extends the exemption of furnace smoke granted in the Public Health Act of 1875 to smoke produced by the operation of reheating, annealing, hardening, forging, converting and carburising furnaces for iron and other metals, and to that produced at mines, during the calcining and smelting of ores, the puddling and rolling of iron and other metals and during the conversion of pig iron into wrought iron. Mr. Nicholson, speaking on the 24th at a meeting of the Royal Sanitary Institute at Hull, argued that these exemptions were not necessary, that the creation of smoke during the processes mentioned ought not to be tolerated, and that its emission represented a waste of coal and was against the interests of the manufacturers.

Electricity Supply in America.

AT a luncheon given in London by the American Chamber of Commerce on April 22nd, Mr. Samuel Insull, who is at the head of an important group of American electrical concerns, dealt with electricity supply developments in the United States. The conditions in America, he said, were very different from those in this country. While in England it was essential to apply to Parliament for powers to supply electricity, in the majority of the States of America it was simply necessary to apply to a Commission and to get a certificate of convenience and necessity. The line of development in the United States would have to be followed to some extent in England. Years ago several different companies supplied electricity in the same town or area, and they tried to regulate a monopoly business by competition, with anything but beneficial results from the point of view of the consumer. Gradually they got to a point at which the cities of the United States were pretty well supplied with electrical energy. The larger developments started with the invention of the steam turbine by Sir Charles Parsons. Dr. Ferranti, another distinguished English engineer, preached the gospel of generation on a large scale, long before it was practised in America, whilst a third English engineer, Mr. Arthur Wright, devised a method of arriving at a proper scale of charges. America owed a great deal to English engineers, who had indicated the lines on which to proceed. People in the United States were perhaps more ready to take up new ideas than they were in England, and they were less respectful towards vested interests. It was a striking fact that Chicago, with a population of four million people, generated within 10 per cent. as many units as were supplied in the whole of the United Kingdom.

A Shipbuilding Chairman's Optimism.

SPEAKING last week at the forty-first annual meeting of Harland and Wolff, Ltd., Lord Kylsant, the chairman, had quite a number of cheering remarks to make about the present position and future of British industry in general and of shipbuilding in particular. Past experience, he said, showed that, when the cost of production was gradually reduced, a period of prosperity in shipping and shipbuilding invariably followed a long period of depression. The shipbuilding industry was one of the first to revert after the war to sound economic principles, and he was confident that in spite of its difficulties during the past six years it would overcome its present troubles. With patience and perseverance it would recover its former prosperity and even surpass it. He had yet to learn that America could compete with this country on equal terms either in shipbuilding or shipping. The exceptional conditions enjoyed after the war by European continental yards were temporary and were gradually disappearing. Whether he looked east or west he could see no reason for apprehension regarding the future of the British industry. The surplus tonnage at present in existence need not disturb the shipbuilders, for it included a large number of vessels which, but for the war, would have been sent years ago to the shipbreaker's yard. In the increasing adoption of motor-driven vessels he saw another reason for encouragement. Lord Kylsant's refreshing confidence, it may be added, was not based on idle optimism, for he was in a position to announce that the company, after meeting depreciation, preference dividend and other charges, was left with a credit on the profit and loss account of over £135,000 and that the reserve fund now stood at £1,300,000.

Thames Bridges.

THE attitude of the London County Council towards the vexed question of the improvement of cross-river facilities within its area has been given a more definite form than it has hitherto possessed as a result of a discussion at the Council meeting on Tuesday of this week. One member sought to urge the Council to open negotiations with the Government, the City Corporation, the Southern Railway, and other parties with the object of securing the abolition of the existing Charing Cross railway bridge and the erection in its place of a new road and railway bridge. The plan proposed did not, it appears, involve the removal of the Southern terminus to the Surrey side of the river, a removal which the railway company some time ago stated would be suicidal to its interests, but the Council never-the-less signified its disapproval of the scheme by defeating the proposal to open negotiations by a good majority. In the course of the discussion it was argued that the proper course to pursue was to proceed with the proposed new Waterloo Bridge and with the suggested bridge at St. Paul's.

H.M.S Centurion as Target Ship.

UNDER the terms of the Washington agreement this country is required to withdraw the battleships King George V., Ajax, Centurion, and Thunderer from service before the end of this year and render them incapable of combatant duty. The first three vessels comprise the "King George V." class, originally consisting of four units, one of which, the Audacious, was sunk by a mine during the war. They were laid down in 1911 displace 23,000 tons, and have a speed of 21 knots, and a main armament of ten 13·5in. guns. They are well-armed ships, with excellent protection, and are still able to attain their designed speed. The same remark applies to the Thunderer, which antedates them by a year and is 500 tons lighter, but has similar gun power and protection. These four vessels are, in fact, more powerful in every way than certain of the battleships retained in the post-Treaty navies of the United States, France, and Italy. The Centurion has been selected for conversion into a fleet target ship under wireless control, and proceeded to Chatham last week for the necessary alterations. When they are completed she will relieve H.M.S. Agamemnon, which has served as target ship for the past four years. The practice of employing redundant battleships as targets is by no means new, but their value for this work has been greatly increased by the introduction of wireless control, which enables the vessel to be manœuvred at fairly high speeds while under fire.

International Steel Union.

THE meetings being held in Paris between French and German steel makers are a continuation of the negotiations which have been carried on intermittently for two years past with the idea of laying the basis of an international steel union. The successful formation of the Rail Union has encouraged the Germans to persevere in their efforts to secure an international organisation of the steel industry in the direction of limiting production to the demand. They received support from the Lorraine makers and eventually from practically all the French steel producers, who saw that as each country was dependent upon the other for coke and iron ore it was necessary to come to an understanding. A preliminary agreement was entered into last year, but it could not be carried into effect until all the industrial questions pending between the two countries were settled by a commercial treaty. The negotiations for a commercial treaty have been repeatedly suspended, but it is fairly certain that they will be resumed when the new French Tariff Bill is passed. Meanwhile the French and German steel makers are carrying the proposed agreement a step further by discussing a limitation of output, which is the main object of the meetings in Paris. The difficulties in the way of organising an international steel union are considerable, although both the Germans and the French believe that they can be overcome. It is hoped that when a workable scheme has been evolved the steel makers of other countries will be induced to join a union which seeks to stabilise the industry at a time when it is liable to suffer from excessive overproduction.

New Shipbuilding Guarantees.

SHIPBUILDING figures largely in the newly published list of guarantees which have been granted by the Treasury under the Trade Facilities Acts, a sum of over £3,500,000 being mentioned in connection with vessels which are to be built either on the Clyde or the North-East Coast. Among the principal applications granted are those of the Norfolk and North American Steam Shipping Company, Ltd., for £400,000 in connection with the building of two vessels at Glasgow and £400,000 for the Gulf Line, Ltd., also for two Glasgow-built ships. The New Zealand Shipping Company, Ltd., is to receive £400,000 for two ships to be constructed on the Clyde, and the Federal Steam Navigation Company, Ltd., £400,000 for two ships to be built on the same river. The Shaw Savill and Albion Company, Ltd., has been granted £675,000 for two liners to be constructed at Glasgow and Wallsend, the Oceanic Steam Navigation Company, Ltd., £675,000 for two ships to be built at Glasgow and Wallsend, and the Commonwealth and Dominion Line, Ltd., £600,000 for the construction of two ships.

The Thorne Colliery Accident.

SOME interesting technical points are brought out in the report which has just been published by the Mines Department on the causes and circumstances attending the accident which took place on March 15th at the Thorne Colliery, near Doncaster. The report is presented by Major H. M. Hudspeth, H.M. Divisional Inspector of Mines. It will be recalled that the accident occurred during the sinking of No. 2 shaft and involved the breaking of a capstan engine, which precipitated the sinking scaffold with its supporting ropes to the shaft bottom, thereby killing six men. The capstan had two 25-ton drums and was worm driven through spur gearing by a twin 14in. high-pressure reversible steam engine supplied with steam at 150 lb. per square inch. At the inside ends of the drums were the worm wheels, which were driven by worms arranged underneath, while ratchets were provided which could engage in certain circumstances with pawls. The Inspector rejects the idea that the reverse rotation of the drums was caused by the pull of the scaffold ropes, and adopts the explanation that the engine driver unwittingly put his reversing lever into the "lower" position, thereby driving the drums against the pawls. As the pawls did not give way the drums were forced upwards, fracturing in all some 40 square inches of the pedestal bearing supports and rising until they were disengaged from the worms and were free to rotate under the weight of the scaffold and ropes. In his concluding remarks Major Hudspeth states that the pawls were so fitted that in the event of the engine being driven against them disaster was bound to result. He further expresses the opinion that pawls should not be fitted on worm-driven capstans, owing to the difficulty of arranging them so that an occurrence of the kind described could not take place.

The Engineering Branch of the Royal Navy.

The object of this article is to place before the readers of The Engineer a short account of the history, development and duties of the Engineering Branch of the Royal Navy, for since the publication of the notorious Fleet Order in November last, it has become more than ever important that the public should appreciate the importance of the position occupied by the engineers of the Royal Navy. To the layman the domestic affairs of our public services often appear complex and confusing. Especially is this the case with naval matters, where the interlocking of naval, civilian, administrative and technical sections is of an elaborate character. The Board of Admiralty is at once the head of a great fighting service, and of a vast industrial organisation. Its activities are many-sided, but while all the various branches of the purely naval service are represented at the Admiralty, many departments at the Admiralty are not represented in the Fleet. The Engineering Branch, it is perhaps unnecessary for us to say, has important duties, not only afloat, but also ashore.

What may be called the three great technical departments of the Admiralty directly responsible for the construction, repair, upkeep and running of the ships of the Fleet and their machinery are the Constructive Branch, the Engineering Branch and the Electrical Branch, presided over respectively by Mr. W. J. Berry, C.B., Director of Naval Construction; Engineer Vice-Admiral Sir Robert B. Dixon, K.C.B., Engineer-in-Chief of the Fleet; and Mr. McClelland, C.B., Director of Electrical Engineering. There are other departments which also deal with technical matters, such as those of the Director of Dockyards, Director of Naval Ordnance and Director of Torpedoes and Mining, the heads of which are Naval Executive officers, but practically all the professional technical assistants employed in them are drawn for the time from the Constructive, Engineering and Electrical Branches. These three branches are also represented by groups of officers in the Home and Foreign dockyards, and it is on their professional knowledge, their zeal and energy, that ship's officers are largely dependent in their efforts to maintain a high standard of efficiency throughout the Fleet. But while the officers of the Constructive and Electrical Branches are civilians, the officers of the Engineering Branch are naval officers, available for duty in shore establishments or in ships.

The Engineering Branch.

The Engineering Branch of the Navy may be said to have had its birth when the Admiralty in 1821 purchased the little Monkey and laid down the Comet, vessels of about 200 tons, fitted with engines built by the famous firm of Boulton and Watt. The great engineer himself was then dead, but when later on the Navy possessed a considerable fleet of steamers, the Admiralty called to their assistance Peter Ewart, who had been an assistant and personal friend of Watt. Woolwich Dockyard was the first home of Naval Engineering, and Ewart took up his residence there in 1835, being then sixty-eight years of age. Two years later an office was opened in Somerset House, and Captain Sir Edward Parry, the Arctic explorer, became Comptroller of the Steam Department at the Admiralty. In 1846 he was succeeded by Captain Ellice, who a year afterwards was followed by Thomas Lloyd, by far the most important engineer connected with the Branch in its early days. Born at Portsmouth in 1803, Lloyd had been trained as a naval architect, but quite early in his career had been detailed to study steam machinery, and he thus became an inspector of steam machinery at Woolwich, and from 1847 to 1869 held the office of Engineer-in-Chief at the Admiralty. His successor in the office was another civilian, Sir James Wright, but on his retirement, in 1887, Richard Sennett, a naval engineer, holding the now obsolete rank of Inspector of Machinery, was made Engineer-in-Chief. Sennett has been followed by Engineer Vice-Admirals Sir John Durston (1889–1907), Sir Henry Oram (1907–1917), Sir George Goodwin (1917–1922) and Sir Robert Dixon.

It will thus be seen that the Engineering Branch of the Navy is not, as many appear to suppose, of recent growth. The steam vessel H.M.S. Lightning was employed in actual warfare in the Mediterranean in 1824; in 1833 the Rhadamanthus crossed the Atlantic to Barbadoes; steam sloops did good work in the Syrian campaign of 1840; and the first shots in the Crimean War were fired by steam frigates. Fighting under sail may be said to have come to an end with the action of the Arethusa, under Captain Mends, against the forts of Odessa in 1854. For many years we clung to masts and yards, but for all practical purposes the knell of the wooden ship and the sailing ship as engines of war was sounded in the Russian War. From that time sailors began to be displaced by stokers, and fifty years later engine-room complements accounted for a third of the men in the Navy. In 1900 there were some 970 engineer officers and 24,000 men; in 1910, 1461 officers and 37,000 men; while during the war the Engineer-in-Chief had under him a body of officers and men exceeding 80,000.

The Engineer-in-Chief.

How the department of the Engineer-in-Chief at the Admiralty came into existence has already been shown, and mention has been made of the officers who have been at its head. Engineer Admiral Dixon has held office since 1922. His immediate staff comprises two groups of officers, those at the Admiralty and those serving as Overseers in the various shipbuilding and engineering centres. Altogether, there are two Engineer Rear-Admirals, nine Engineer Captains and thirty-four other officers on his staff, and most of them have passed through the higher courses of training at the Royal Naval College, Greenwich. The design of new machinery, the preparation of specifications, the production, inspection and testing of main and auxiliary machinery driven by steam, water and oil, are all dealt with by these officers. The Engineer-in-Chief also advises on questions of large repairs, and alterations and additions to ships in commission; he is consulted by the Director of Dockyards as to the extension of workshops and machinery; fills certain duties in connection with the Fleet Oilers and has charge of the Experimental Oil Fuel Station at Haslar, and also of the Admiralty Engineering Laboratory at West Drayton, where difficult problems in connection with the machinery of submarines have been successfully solved. The wide scope of these duties will be realised by those familiar with modern developments. The cost of a fighting ship may run into some six millions of pounds sterling, and of that sum one-half to three-fifths may be due to the various machinery contracts. A battleship is an epitome of the application of scientific discovery and mechanical invention, and her engine-room is a floating super-power station.

Director of Dockyards.

The engineering work done under the Director of Dockyards is only second in importance to that done under the Engineer-in-Chief. The history of our yards goes back to Henry VIII., but the introduction of mechanical engineering as distinct from the old mill-wrighting was due to Sir Samuel Bentham, who installed steam engines, and Brunel, whose wonderful block-making machinery marked an epoch in dockyard practice. Simon Goodrich, who trained some of the earliest naval engineers, was Mechanical Engineer of Portsmouth from 1799 to 1831. But, as already remarked, Woolwich, not Portsmouth, was the cradle of naval engineering. Ewart and Lloyd at first had their offices there, and in 1838 a steam factory was erected. About the same time Thomas Hamshaw became engineer of Malta Yard, and by 1846 there were engineering shops at Chatham, Portsmouth and Devonport. Among the civilian officers found in them were Andrew Murray, a student of Edinburgh and an assistant of Fairbairn, and Charles Atherton, a Cambridge Wrangler and a pupil of Telford.

Naval Engineering from the first was associated with many famous engineers, and it is a misconception to think that the early engineers in the Navy were all men of little or no education. Just as the office of Engineer-in-Chief in 1887 was filled by a naval engineer, so the appointments at the yards had gradually ceased to be held by civilians, the much esteemed John Dinnen being the first naval engineer to hold such a post. To-day naval engineers hold all the appointments in the engineering departments at the yards, some fifty experienced officers being borne for this duty. At each yard will be found drawing and estimating offices, foundries, smitheries, boiler-shops and fitting and turning shops, each Dockyard constituting an engineering concern comparable with the largest of industrial establishments. The principal duties of the Engineer officers consist in directing the fitting of new machinery aboard ships, the repair of the machinery of ships in commission, and the general oversight of yard machinery. In carrying them out the officers are assisted by foremen, inspection and chargemen who supervise the actual work, the total number of subordinate officers and men reaching some 15,000.

Naval Ordnance and Torpedoes.

Two further departments of the Admiralty which are especially dependent on their engineering staffs are those of the Director of Naval Ordnance and Director of Torpedoes and Mining. It was in 1869 that chief engineers afloat were first directed to inspect iron gun mountings, and if necessary to repair them, and a few years later care of the steam turret gear was added to their responsibilities. Engineer officers were also appointed for the re-venting of heavy guns, and it was Edward Newman, Chief Engineer of Portsmouth Yard, who, in conjunction with Captain Grenfell, worked out one of the first designs for a hydraulic gun mounting. For some years an engineer was borne on the staff of the Engineer-in-Chief for gun mounting work, but on the formation of the department of Naval Ordnance, Engineer officers were attached to it. Their work is a specialised form of mechanical engineering, but the officers employed have a thorough knowledge of all the machinery of warships. At present they are known as Engineer Inspectors, a title which does little justice to their relative importance. At the head of the inspectors is an Engineer Admiral, who is assisted by six naval engineers at the Admiralty and thirteen others stationed at the works of Armstrong, Vickers, &c. A modern turret and its guns may weigh over 1400 tons, and the whole of the training, elevating and sighting of the guns, and the loading and transportation of ammunition is done by hydraulic machinery, for which the Engineer officers are responsible. In complexity a modern gun-house rivals the main engine-room, while the machinery is of a very costly character. In the Dockyards the gun mounting work is also carried out by Engineer officers who, in addition, take charge of spare mountings and deal with rangefinders, telescopes, instructional appliances, &c.

Just as the coming of the steam and hydraulic gun mounting called for engineering knowledge, so did the introduction of the torpedo. Whitehead invented his automobile torpedo in 1866. For over twenty years the torpedoes in ships and all the stores for them were in the charge of the Engineer officers, and engineers have played a very important part in the development of this particular weapon. Torpedo work comes under the Director of Torpedoes and Mining, a torpedo specialist of great experience, but the Torpedo Depôts at the Naval ports, the Torpedo factory at Greenock and the Mining Depôts at Frater (Portsmouth) and Wrabness (Harwich) have from the first been in charge of engineer officers.

Other Occupations.

Besides the Admiralty and Dockyard departments referred to, Engineer officers are employed in various other sections. An Engineer Admiral is borne on the staff of the Second Sea Lord in connection with the *personnel*, and others serve in the Naval Intelligence Division, and under the Director of Naval Equipment and the Director of Armament Supply. Officers of the Engineering Branch are inspectors of coal in Wales and the North, inspectors of oil in Persia, and they are found on the staff of the Chemical Warfare Station at Porton, while an Engineer Commander is assistant *attaché* at Washington.

From this brief sketch it will be seen that many important and interesting appointments at the Admiralty, calling for the highest professional training and the widest experience, are open to officers of the Engineering Branch. The work in many cases is that of administration, and that there should ever have been a dearth of cadets from Dartmouth anxious to prepare themselves for these appointments can only be explained by the existence of a suspicion that the standing of an engineer was inferior to that of a torpedo officer or gunnery officer or by a feeling of uncertainty as to what the future of Engineer officers was to be. With the Engineering Branch and its work in the Fleet we deal below.

Naval Engineers and the Fleet.

Having thus briefly reviewed the work of the Engineering Branch of the Navy at the Admiralty and in the Dockyards, we now turn to consider more fully first the history of the Branch, and then its work in the Fleet. The story of the rise of the naval Engineer is, perhaps, without parallel. Though, at first, as undesired in the Navy as is a girl in a Chinese family, his usefulness led him to be tolerated, but when, with the progress of invention, he became indispensable, the toleration gave way to other feelings. But whether the Engineer was regarded with jealousy or with dislike, the advance of engineering could not be stayed, the shipwright had to abandon saw and adze for shears and punch, the rigger and sailmaker gave way to the boilermaker and fitter, and ships gradually changed in character. To-day, as everyone knows, a man-of-war is a product of engineering from stem to stern, its spaces are fitted with machinery, and only those trained in engineering science and the hard school of practical mechanics, are masters of the structure and its engines.

When the Naval Engineer first made his appearance he was a mechanic straight from bench and forge. Millwrights, blacksmiths, whitesmiths and such, all found their way into the early steamers, and there is no need for surprise at the traditional story that the qualifications of one were that he had made and sold gridirons at fourpence apiece, or four for a shilling. These pioneers matriculated in the same school as George Stephenson. From 1821 to 1837 they were just engine-men who came and went as they chose. Of their wanderings we know little, save that the Commanding Officers were as perplexed as to how to retain the good ones as is a mistress to keep her maids. According to that greatest of Admiralty Secretaries, John Barrow, the first official order relating to the engineers was issued in 1835, commanding officers of steamers then being enjoined to forward monthly statements as to their engines, defects, fuel, &c., the last clause being devoted to "the conduct of the engineers during the month."

With the advent of Captain Sir Edward Parry at the Admiralty in 1837, things underwent a great change. The engineers were made warrant officers, first, second and third-class, records began to be kept and a system of training was inaugurated. The claim to be the oldest of naval engineers was probably allowed to Andrew Witham, whose name is the first on the Registers. Witham was born as far back as 1780. He had learnt his trade at the Butterley Ironworks, which still flourish, had worked for the Duke of Portland, and for years had served in the steam packet

Service, then under the Admiralty. In 1837 it is recorded of Witham that he was "a very careful good engineer, quite competent to take charge of and repair engines, but having neglected his education when young is only fit for a second-class."

By 1837 there were some twenty-seven steam paddle sloops and despatch vessels in the Navy, and the number was rapidly increasing. From that time onwards the story of the naval Engineer is to be found in a long series of Orders in Council, Circular letters, Memoranda and bulky reports of Committees. These documents illustrate the official side. Another side is presented by the various statements of grievances, petitions, pamphlets on reform, and by hundreds of articles and letters in the Press. Further information can be gleaned from the books on steam engines written by Naval Officers. Though they were in a minority, there were many young naval officers who saw what the coming of steam meant, and prepared themselves for it. Such were Robert Otway, Spenser Robinson, Cooper Key, Williams, Gordon and William Mends. These officers not only studied steam, but took off their coats and worked at the bench, while some of them compiled excellent text-books on modern engineering.

The Position of Naval Engineers.

To follow in detail the many changes in the recruiting, the training and the position of the Naval Engineers from 1837 to 1926 is impossible here, but some of the principal steps by which they have risen may be indicated. In 1841 the Engineers were granted a gold band on cap and steam engine buttons on coat and collar. Next year, to stimulate them to higher things, the grant of a silver medal for "ability and good conduct" was inaugurated. But things were moving too fast for medals to satisfy, and in 1847, the year Lloyd went to the Admiralty, an Order in Council created the ranks of Inspector of Machinery, Chief Engineer First, Second and Third Class, and Assistant Engineer First, Second and Third Class, ranking with the Masters and Assistant Masters. Chief Engineers were commissioned officers, had entrance to the wardroom, and a year or two later appeared in the Navy List. Some of them have left a name behind them, and the following notes should dispel the idea that the early engineers had no educational attainments. Chief Engineer Thomas Brown had been one of six boys trained as gentlemen apprentices for Naval Service in Portsmouth Yard in the '20's. With Professor Main he was the author of Brown and Main's "Marine Steam Engine," and for years lectured on steam to naval officers at Portsmouth, where the little Bee, fitted with both screw and paddle was at their service. His co-apprentice, Thomas Baker, was engineer of the Queen's Yacht Victoria and Albert, and as such attracted the attention of the Prince Consort. Baker was the first naval Engineer to become Chief Engineer of one of the home dockyards. The father of the profession of Naval Engineering was John Dinnen, a Portsmouth Grammar School boy. An able engineer, as ready with his pen as with his wit, a fluent talker of French and Italian, sought after by Commodores and Admirals, Dinnen was a member of the Institution of Civil Engineers, and was the first Naval Engineer to write a technical paper. It was published in 1838. A great ornament to the Service, Dinnen met his death through an accident outside the Admiralty in 1866, and now lies in Highgate Cemetery. His position among his fellows is indicated by the story that when his brother William, a far lesser man, was promoted, another officer wrote:—"Dear William, promotion cometh neither from the east nor from the west, but from thy brother John." John Dinnen was made Inspector of Machinery in 1847, and that year marked the entry into Portsmouth Yard, as an engineer boy, of Mr. Harry Williams, R.N., the only officer alive to-day holding the obsolete rank of Chief Inspector of Machinery.

As might be expected, the Crimean War led to a great development of the Engineering Branch of the Navy. Of the new entrants many were undesirable and soon disappeared. A shortage of likely men led Chief Engineer George Murdoch in 1859 to tour the shops of Newcastle, Leith and Glasgow, his recruits being known as "Murdochites." Striving for better conditions his brother officers looked on helpless, and Murdoch afterwards regretted his own success. Yet we owe the first edition of the "Steam Manual" to one of these officers recruited by Murdoch. In the '60's the engineer boys became engineer students, and some gained admission to the Royal School of Naval Architecture and Marine Engineering at South Kensington. Such well-known men as Seaton, Sennett Corner, Chilcott, Durston, Mayston, Milton and Morcom were graduates of this school, the activities of which, in 1873, were transferred to Greenwich College. The attitude towards engineers at this time, however, was not very encouraging, for in two years sixty-three Engineer officers were tried by Court-martial against forty-five of all other ranks, some of the courts being ordered to try minor technical failures.

Engineer officers had already, in 1859, issued a pamphlet, "The Case of the Naval Engineer." It was followed by a petition to Parliament in 1866, another pamphlet in 1867, and yet another in 1872. In 1868 the new class of petty officers, Engine Room Artificers, had been established, partly owing to the recommendation of Admiral Cooper Key, and in 1875 that distinguished officer was made Chairman of a Committee of two Captains and two Engineers to inquire into the best means of securing the highest mechanical skill and scientific knowledge for the Engineering Branch. Through the recommendation of the Committee, separate messes for Engineers were abolished, H.M.S. Marlborough was allocated as a home for Engineer students, and the plans for Keyham College were laid down. The Committee, moreover, brought the Engineers in sight of the promised land by recommending that they should have military status. But the conservative forces were too strong. Forty years later, military status was granted, only to be taken away again in November, 1925.

Reform.

Throughout the 'eighties and 'nineties, the agitation for reform went on unceasingly; and in 1887 Fleet Engineer Quick received the thanks of the Admiralty for his "Proposed Organisation of a Combatant Corps of Royal Naval Engineers." But it all seemed labour in vain, and Naval Engineering as a profession became vastly unpopular. Keyham College ceasing to attract, Assistant Engineers were entered from technical colleges and recognised workshops, but by the end of the century the position was as bad as it well could be. It was then that the late Mr. D. B. Morrison took up the matter, and the subsequent developments have been ably reviewed in the Memorandum issued by the Joint Committee of the Engineering Institutions—see THE ENGINEER, March 19th, 1926—which, in January of this year, waited upon the First Lord of the Admiralty, Right Hon. W. C. Bridgeman, to protest against the much-discussed Fleet Order No. 3241 of last November.

As the main points in connection with the introduction, the modification, the partial failure, and now the abandonment of the Selborne-Fisher scheme for common entry, common training and equality of status are fairly well known, there is no need to dwell on them here, but it should be pointed out that the training of no other section of the Navy has been subject to so many changes as the training of Engineers. Many of these changes have been wholly unnecessary, they have not been brought about through the representations of Engineers, and they have been very wasteful of public money. These changes, moreover, reflect the vacillating policies of successive Boards of Admiralty towards engineering matters, which have militated against the development of that *esprit de corps* which should exist in all our public services.

The Engineering Branch.

The Engineering Branch of the Navy to-day has a *personnel* of about 23,000 or 24,000 officers and men. A glance at the Navy List will show that there are some 1300 officers of various grades ranging from the rank of Engineer Vice-Admiral to that of Warrant Engineer. Owing to those changes to which reference has been made, these officers have come from many sources. Some of them entered Keyham College under the old *régime*; some came from technical colleges; about 250 are representatives of the new type of officer from Dartmouth College; a few have passed through Keyham after entering from the public schools; a large number are officers promoted from the ranks of the Engine Room Artificers, and there is also a group of officers who have risen from the stokers' mess deck through the grade of Mechanician. The Engineering *personnel* as a whole is made up of some 1300 officers, 4000 artificers and 18,000 stoker ratings. When coal burning was general, engine-room complements had to be bigger than they are to-day when oil is being burnt, and in some vessels the engine-room complement exceeded in numbers all the rest of the ship's company.

Officers and men of the Engineering Branch are employed wherever the White Ensign flies. In all the Home ports and in the various fleets there are larger contingents, while artificers and stokers are found on the rivers of China and other out-of-the-way places. Perhaps the largest section of the Engineering Branch to-day is stationed in the Mediterranean. There the Fleet recently included eight battleships, ten cruisers, four flotilla leaders, thirty-four destroyers and six submarines, together with an aircraft carrier, a repair shop, depôt ships, sloops, mine-sweepers, trawlers, &c. The horse-power of each battleship of the "Queen Elizabeth" class is 75,000, that of the "Iron Duke" class 29,000, the cruisers and flotilla leaders have engines of 40,000 horse-power; while the destroyers are of 27,000–30,000 horse-power. Taking the whole Fleet with its auxiliaries, the aggregate horse-power is something like 2,000,000, and if the whole Fleet were to steam full speed for twenty-four hours, it would consume over 20,000 tons of oil fuel.

The "source and magazine" of all power in a ship lies in her boilers, but her stokeholds contain not only boilers, but such things as feed pumps, oil pumps, and forced draught fans. The various engine-rooms likewise house not only the steam turbines, but condensers, air pumps, electric light engines, hydraulic engines, air-compressing machinery, distilling machinery, refrigerating plant, and so on. One of the tasks of the engine-room staff is to keep in order the complicated system of steam and water pipes running throughout a ship. Then, too, there are the water-tight doors and innumerable fittings for ventilating, pumping and draining to be maintained in good order. It is one of the first duties of an Engineer Officer to make himself thoroughly acquainted with the structure of the ship and its many water-tight compartments, and to learn how they can be flooded or drained in an emergency.

The care and maintenance of the great mass of machinery in a warship calls for a large and competent staff. A battleship carries some eight or nine Engineer Officers, a cruiser four or five, and the destroyers and submarines one each. There are about four times as many artificers and twenty times as many stokers. Altogether, the squadrons of the Mediterranean require about 200 Engineer officers, 800 artificers and 4000 stokers. At sea, the staff of a ship is divided into three watches, each watch doing four hours' duty out of every twelve. Steaming under way, however, is but the test of the work done in harbour. When in port there are periodical surveys, inspections and tests to be made, defects large and small have to be made good, and there is always work and to spare. Each division of the Fleet has its Squadron Engineer Officer, who is on the Staff of the Admiral, but each Engineer Commander is supreme in his own engine-room, and is directly responsible to the Captain of his ship for the efficiency of his department. The second Engineer Officer in a ship is always known as "the Senior Engineer," and it is upon his shoulders that the direct oversight of the manifold activities of the engine-room falls. The other officers keep watch at sea and are responsible for certain sections of the ship's machinery in harbour. To run successfully the engine-room department of a battleship demands a thorough professional training and wide experience, and calls for sound judgment, readiness of resource and decision. Needless to say, another qualification is that of knowing how to handle men. Endowed with lesser powers of command than upper deck officers, the Engineer has to maintain discipline, and it is a strange thing that even to-day an officer in charge of machinery exceeding 100,000 horse-power, and perhaps 400 men, is not considered a fit person to sit on the Court-martial of a stoker.

It is seldom that the engine-room department of a ship is brought to public notice. There have been such incidents as the patching of the boiler of the Safieh by Engineer Henry Benbow, "the man who mended the boiler," and the escape of the Calliope from the harbour of Apia during a hurricane, for which Staff-Engineer Bourke and his officers and men received the thanks of the Admiralty. But unusual pluck, heroism, presence of mind and exceptional devotion to duty in the engine-room often go unnoticed. Many tributes were paid to the steaming of the Fleet during the war, and, judged by any standard, the work of the Engineering Branch was one to be proud of. It is unfortunate for several reasons that no account of it has been published. The remarkable steaming of the Kent, the bringing home of the damaged Marlborough and Lion, and the exceptionally fine work of the Engineering staff of the Inflexible when she was mined in the Dardanelles, are but four instances which would at once illustrate the important duties of the Engineering Branch and the high state of efficiency maintained throughout the war. With a smaller Navy and a reduced *personnel*, a high degree of efficiency is more essential than ever, and every effort should be made to remove every cause for discontent and to promote harmony among the various branches of the Service.

Alternating-current Pressure Regulators.

No. III.*

Interesting views on voltage and power factor regulating equipment on lines used for interconnecting large generating stations were given in a paper read last December before the American Institute of Electrical Engineers by Mr. H. C. Albrecht. The author's object was to indicate as far as possible the field in which transformers provided with tap changing equipment might be economically and satisfactorily applied. When step-up transformation is involved voltage regulation requirements in America have usually been related to one-way transmission, but the tremendous growth of capacity of the individual systems within the last decade and the decided trend towards the interconnection of systems have given rise to another problem, namely, that of controlling voltage and transferring reactive kilovolt-ampères with reversible energy flow. Until the recent development of tapping-changing equipment, the induction regulator and synchronous condenser were used exclusively in America. The best solution to many problems is, in Mr. Albrecht's opinion, to be found in a combination of tapping-changing equipment with synchronous condensers, or in certain cases, when its range is sufficient, the use of tapping changing equipment alone. There are, of course, cases in which bulk supply is transmitted to distant points, and in which it is practicable to obtain some or all of the regulation necessary by varying the voltage at the generating station, particularly where there is no local distribution at that point.

Synchronous condenser equipment has been used

* No. II. appeared April 23rd.

extensively in America for voltage regulation, particularly for one-way transmission. It has the ability to carry reactive kilovolt-ampères, thus minimising losses and permitting the best utilisation of the system. It will give smooth voltage regulation, and when necessary in cases where the charging kilovolt-ampères of the line is high, it will prevent voltage rise at light loads. It will also maintain level voltage transmission, which may be an advantage when loads are tapped off along the line. The cost of a complete condenser equipment is, however, high. Operating and maintenance costs are also appreciable. The losses are high, although they are generally more than balanced by the savings in the losses of the system. When it is required to deal with the reversal of energy the cost of the condenser installation is great, as duplicate equipment must be installed at each end of the line, with possibly little additional saving in the system capacity or losses to offset the additional investment.

The cost of the tapping-changing transformer system is, however, low, for it is practically only the difference between that of the ordinary type of transformers and those with tappings. The system adapts itself to reversible energy transfer where the line power factor is high or the distances are relatively short. The scheme is incapable of improving the system power factor, and of decreasing the losses, and it will not give very fine voltage regulation.

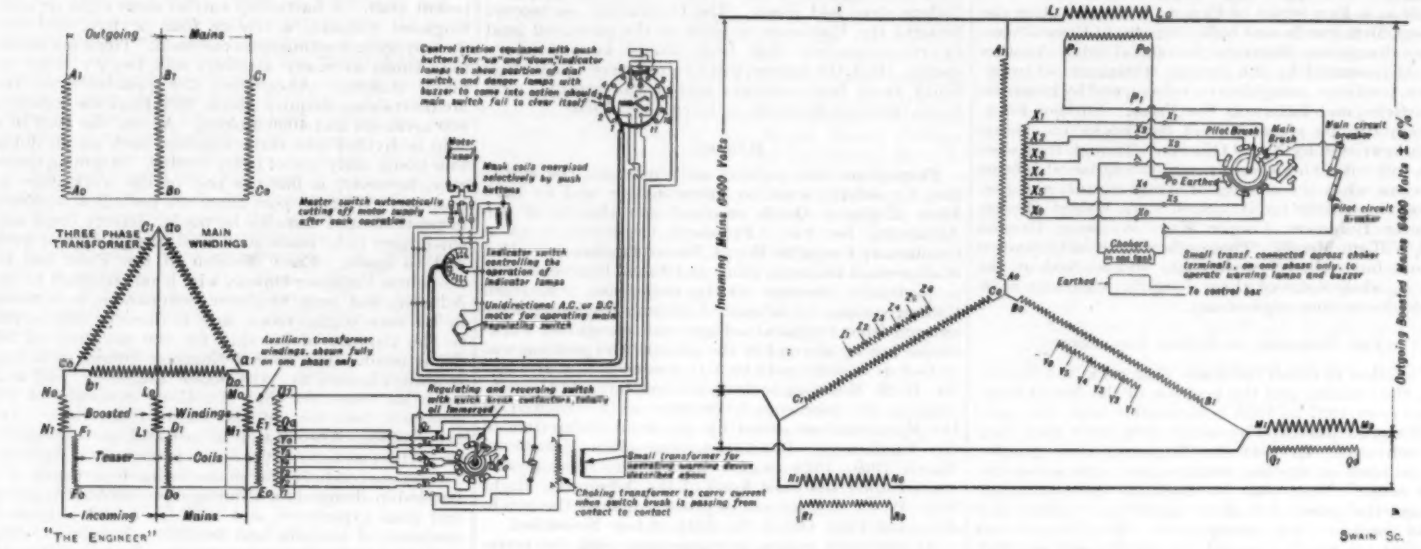
Induction regulators have been used in America to a limited extent on the low-tension side of transformers connected with high-voltage transmission lines, and have the following characteristics:—(1) Moderate cost; (2) ability to reverse the transfer of current; (3) ability to give smooth voltage regulation; (4) inability to improve the system power factor, and thus decrease losses and increase the system capacity; and (5) moderate losses. Induction regulators and transformers with tap-changing equipment serve very much the same purpose—they vary the voltage, but have no beneficial effect on the power factor on the system as a whole. Of the two kinds of equipment, the tapped transformer is cheaper, more efficient, and it occupies less space.

There are several methods of changing the tappings of a tapped transformer whilst it is under load, some of which are as follows:—(*a*) Two parallel windings may be used, and cut out of circuit one at a time by oil circuit breakers, or contactors, in order to change the tappings; (*b*) a one winding transformer may have adjoining tappings momentarily connected together through oil circuit breakers during the change over with a bridging reactance or small induction regulator; or (*c*) one winding in which the tappings are changed by taking each phase out of service in succession, the load being carried in the meantime by the two remaining phases, which are connected open delta. In the cases (*a*) and (*b*), the windings from which the tappings are taken may be those of the main transformer or of an auxiliary transformer excited by the main bank. Whilst the former arrangement is the most compact and is cheaper, both with regard to first cost and operation, it does not allow of all the tapping-changing equipment being kept outside the main tank. When it is desired to regulate an existing bank of transformers an additional regulating transformer may be employed. Booster transformers, which may be used in conjunction with new or existing transformers, are made in this country by the British Electric Transformer Company, and will be described later.

An 80,000-kilovolt-ampère installation of transformers with tapping-changing apparatus has been installed at the Chester generating station of the Philadelphia Electric supply system. This station is 14 miles from the Schuylkill generating station, to which it is connected by means of two 66-kilovolt lines. Until recently two 18,750-kilovolt-ampère banks of transformers were installed at each end of the line. Although these lines were originally intended only for connecting the two stations, two large and important consumers had to be connected at about the centre of the lines.

During the first two years of operation the control of the load transfer and that of the reactive kilovolt-ampères was obtained by varying the bus-bar voltage of the Chester generating station, as the local distribution was not extensive and the local variation in the voltage was apparently not of great importance. In the year 1920, however, this practice became impracticable. Two 1750-kilovolt-ampère 13,600-volt induction regulators, to give a 9 per cent. buck and boost in a 18,750-kilovolt-ampère circuit, were accordingly put into service at the Schuylkill end of the lines, these probably being the largest regulators of the kind that have so far been built. In 1924 it was decided to double the transformer capacity at the Chester station and to extend a 66-kilovolt tapping from the line to a 20,000-kilovolt-ampère sub-station, the transformers at the Chester station being transferred to that point.

The increased loading of the line naturally gave rise to a greater voltage drop, and it was deemed advisable to provide the new transformers at the Chester station with tap-changing gear, instead of using additional induction regulators or installing synchronous condensers. Induction regulators with a 5 per cent. buck and boost were, however, purchased for the sub-station, as tapping-changing gear could not be conveniently applied to the sub-station transformers. Four 20,000-kilovolt-ampère 13·8/69-kilovolt delta-delta, three-phase water-cooled transformers were put into operation in November of 1925, with six tappings on the low-tension side to give a 13 per cent. rise in pressure at no load in the high-pressure winding. The low-tension windings are in two parallel circuits, with tappings in the middle of each winding, the tappings being changed on one winding whilst the other temporarily carries the entire load. A single operation of a control switch serves for making


Outgoing Mains
THREE PHASE TRANSFORMER
MAIN WINDINGS
Boosted Windings
Teaser Coils
Incoming Mains
"THE ENGINEER"
Control station equipped with push buttons for "up" and "down" indicator lamps to show position of dial switch, and danger lamps with buzzer to come into action should main switch fail to clear itself
Motor cut-out
Mask coils energised selectively by push buttons
Master switch automatically cutting off motor supply after each operation
Indicator switch controlling the operation of indicator lamps
Unidirectional A.C. or D.C. motor for operating main regulating switch
Auxiliary transformer windings, shown fully on one phase only
Regulating and reversing switch with switch break contactors, totally oil immersed
Small transformer for operating warning device described above
Choking transformer to carry current when switch brush is passing from contact to contact
Incoming Mains 6600 Volts
Outgoing Boosted Mains 6600 Volts ± 9%
Pilot Brush
Main Brush
Main circuit breaker
Pilot circuit breaker
To Earthed
Chokers in one limb
Small transf. connected across choker terminals, on one phase only, to operate warning lamps and buzzer
Earthed
To control bar
SWAIN Sc.

FIGS. 22 AND 23—DIAGRAMS OF CONNECTIONS FOR BERRY STEP-BY-STEP PRESSURE REGULATORS

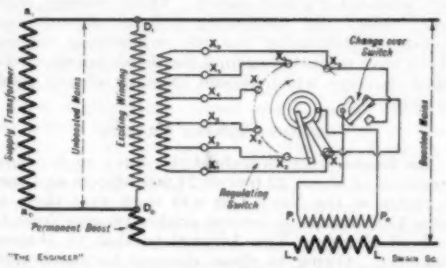


FIG. 24—CONNECTIONS FOR SINGLE-PHASE REGULATING TRANSFORMER

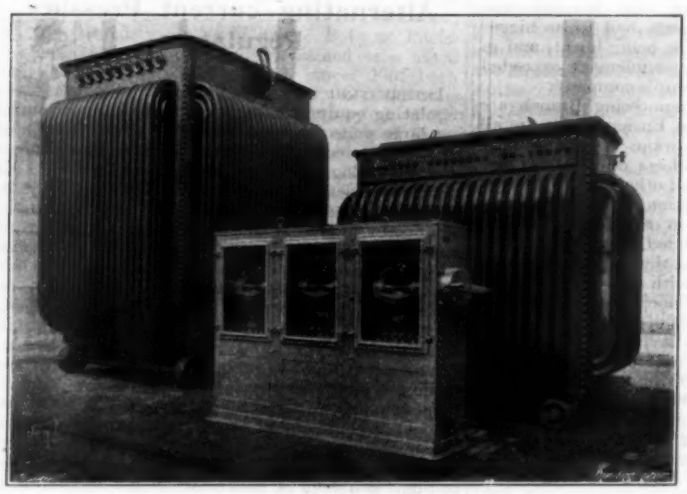


FIG. 25—BERRY THREE-PHASE TRANSFORMER AND BOOSTER

FIG. 26—BERRY BOOSTERS FOR SCOTT-CONNECTED MAIN TRANSFORMERS

the complete change from one tapping to another on all the three phases. Since their installation in 1925 these transformer have operated very satisfactorily.

a constant voltage at that point, irrespective of the variation of the voltage on the 66-kilovolt line, due to the direction and amount of energy transferred.

bus-bars, and the other six to the 66-kilovolt bus-bars through transformers directly connected to the generators, the bus-bars being connected together

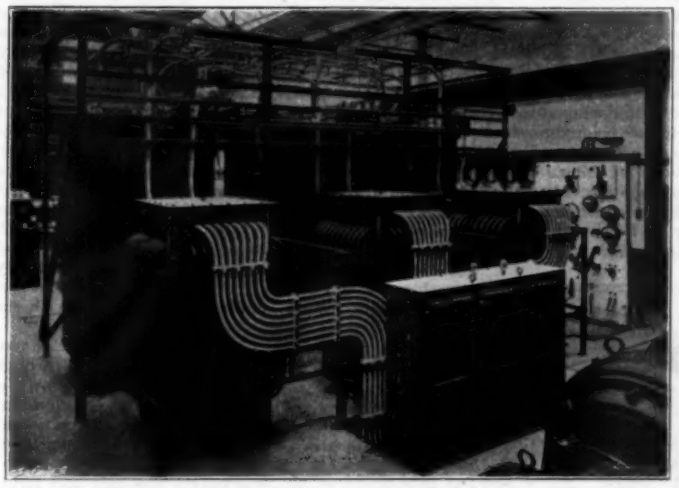


FIG. 27—BERRY MAIN TRANSFORMERS AND BOOSTERS

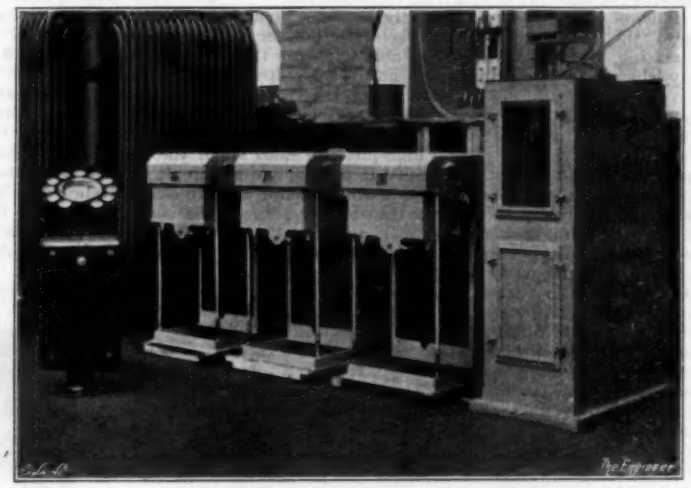


FIG. 28—BERRY REGULATING PANEL AND SWITCHES

Their control is said to be quite simple and tapping changes of 2·2 per cent. cause no noticeable dis-

The Richmond station at Philadelphia will ultimately contain twelve 50,000 kilowatt sets, the first

through three transformer banks. As within the next few years there will be considerably more distribution at 13·2 kilovolts than there will be at 66 kilovolts, the first generators installed will be connected to the 13·2 kilovolt bus-bars, but in order to facilitate the ultimate reversible transfer of energy between the two sets of bus-bars, the transformers for coupling the bus-bars are to be provided with tap-changing equipment with a total range of 10 per cent., to be made in four 2½ per cent. steps. Individual tapping-changing equipment will be supplied with each single-phase transformer, and there is to be no provision for ensuring that the tappings on the three different phases will be made simultaneously. Each bank of these transformers will consist of three 20,000-kilovolt-ampère water-cooled single-phase units.

A requirement of the Philadelphia Electric Company is that the tapping-changing equipment inside the tank should require no attention other than that which would naturally be given on the rare occasions when it is necessary to take the transformers out of the tanks in the event of a winding failure. The amount of tap-changing range that is practicable and the effect upon cost, &c., are interesting subjects for discussion, and naturally have an important bearing upon the application of the system, particularly for reversible energy transfer. Whether oil switches or contactors should be used for disconnecting devices and the relative merits of different types of ratio adjusters are matters to be considered in connection with individual applications of the scheme. Provision must, of course, be made for manual operation in the case of motor

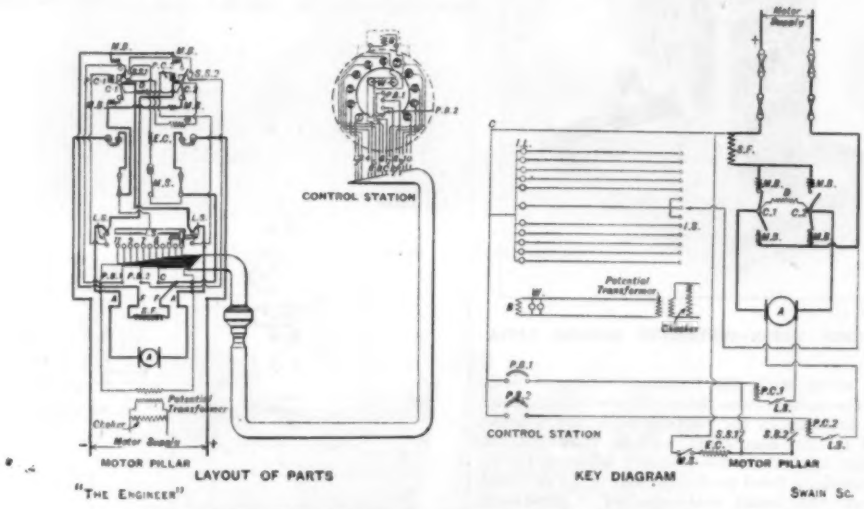


FIG. 29—CONNECTIONS FOR BERRY REMOTE-CONTROLLED REGULATOR PANEL

turbances on the line. While the tapped transformers at Chester and the regulators at Schuylkill are non-

two of which, we believe, are now in operation. It is anticipated that about one-half of the minimum

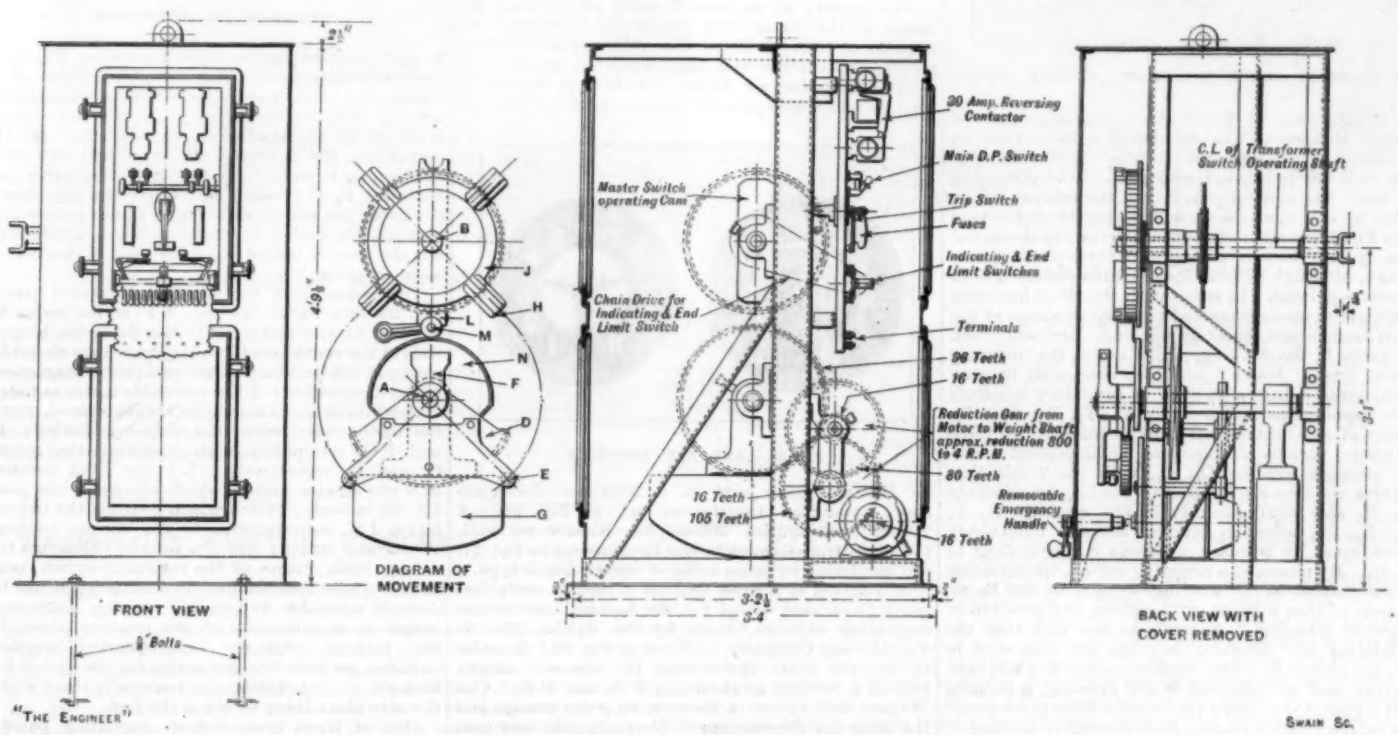


FIG. 30—MOTOR OPERATING GEAR FOR BERRY REGULATING PANEL

automatic and are under the control of attendants, the regulators at the sub-station are controlled by means of a contact-making voltmeter, which ensures

ultimate capacity of this station will be distributed at 13·2 kilovolts and the remainder at 66 kilovolts. Six of the generators will be connected to the 13·2-kilovolt

trouble or failure of the control system. The complete movement, whether remotely or manually operated, should be made in the smallest possible

period of time, without shock to the mechanism or sacrifice in durability. That portion of the tap-changing mechanism external to the transformer should be properly housed and designed to withstand the effect of moisture arising from condensation.

It is, of course, essential that the operator should know the tapping on which each transformer is operating, and that he should be able to ensure that any change in the connections has been properly completed. A position indicator must therefore be provided on the switchboard and on the mechanism itself. Costly high-voltage potential transformers for giving the voltage on the high-pressure sides of transformer banks may be avoided if the voltage is measured on the low-pressure side and account be taken of the drop in through the transformer. Since, in the case of tap changing, however, the actual ratio of transformation is varied, it is necessary to provide some device, such as a small auto-transformer, which also has its ratio varied in a corresponding manner by a dial switch operated by the regulating mechanism. The usual differential relay protection is also affected by the change in the transformation ratio, and certain modifications must be introduced. Any failure of the mechanism that may damage the transformer winding thermally must be guarded against, and should such a failure occur it should be indicated by means of an alarm. In the case of the double-winding transformers at Chester, this is accomplished by relays which are connected differentially between the two windings, and which operate when either winding is carrying all the load or when the two windings are in parallel on different tappings. These relays operate a definite time limit relay, which gives an alarm at the end of a period of one minute.

The Berry step-by-step booster regulator, made by

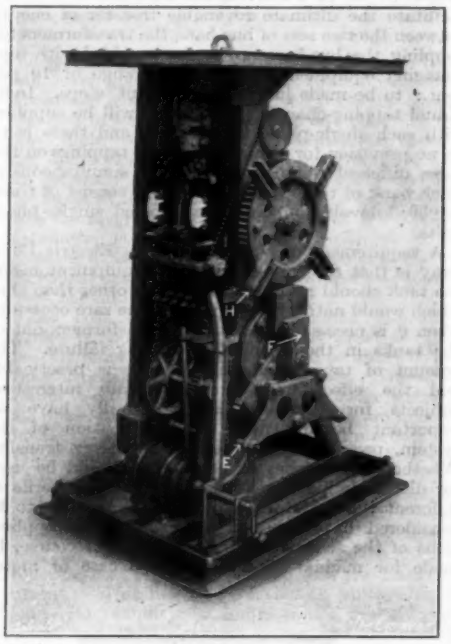


FIG. 31—BERRY MOTOR-CONTROLLED BOOSTER PANEL

the British Electric Transformer Company, Ltd., of Hayes, Middlesex, was developed with a view to providing an arrangement whereby the switching is done at a low pressure, irrespective of the voltage of the line. The general principle of the scheme, which is not by any means new, will readily be understood from Fig. 22, which for the sake of simplicity shows the idea applied to one phase of a three-phase transformer, although in practice all three phases are, of course, regulated. In series with the three incoming leads to the mesh-connected primary windings of the main transformer, boosting windings are connected, as shown in the drawing, whilst across the incoming mains three "teaser" coils are connected in star. These coils induce a voltage in secondary windings with tappings as indicated by Y_1, Y_2, Y_3, &c. By means of an oil-immersed switch connected to these tappings, various voltages can be impressed across the primary winding Q_0, Q_1, with the result that various voltages are induced to the booster windings M_0, M_1 and simultaneously in the windings L_0, L_1 and N_0, N_1, which in practice are also inductively acted upon by primary windings corresponding to Q_0, Q_1. By means of a reversing switch, the direction of the current in the windings Q_0 and Q_1 can be reversed, so that a boost can be given in a positive or negative direction. Apart from the fact that the regulating and reversing switches are immersed in oil, the circuit is always broken on quick-break contactors, and, as indicated in the drawing, a choking coil is provided to carry the current when the regulating switch brush is passing from contact to contact.

The drawing—Fig. 22—relates to a motor-operated regulating switch controlled from a distance by push buttons, the position of the switch arm being indicated by a signal lamp on each point, and there are also danger lamps and a buzzer which come into action in the event of the main switch arm having been brought to rest between any two pairs of contacts. The warning device, it will be noted, is operated by a small transformer with its primary winding connected across the choking coil, which carries the current when the brush of the regulating switch in passing from one contact to another.

The diagram—Fig. 23—shows the main connections for a 12,000-kilowatt three-phase regulating set. Here, again, the regulating connections for one phase only are shown, the application of the scheme to the remaining two phases being left to the imagination of the reader. The main circuit breaker and pilot circuit breaker associated with the regulating switch are clearly indicated. The diagram—Fig. 24—shows the connections for a single-phase regulating transformer boosting on the "outer." In this particular case a small permanent boosting coil is shown con-

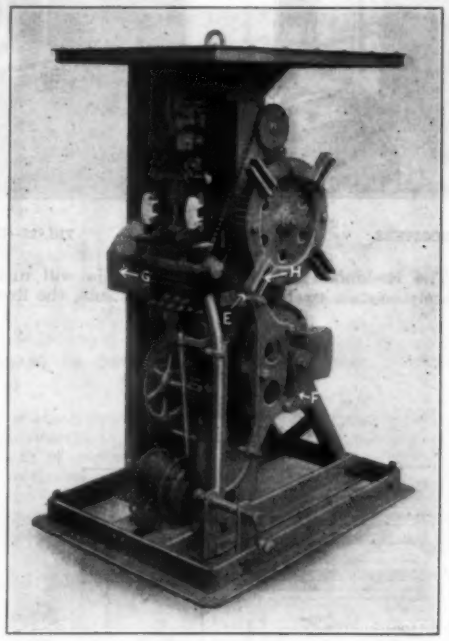


FIG. 32—BERRY MOTOR-CONTROLLED BOOSTER PANEL

nected in series with the "outer," this coil being wound on the same core as the exciting winding, which induces a pressure in the tapped secondary winding connected to the regulating switch that controls the pressure applied to the primary winding P_1, P_0. If, for example, a total positive boost of 18 per cent. is required, the small coil—marked "permanent boost"—might be designed to give half the total boost, or 9 per cent., and the boosting transformer proper the other half. Obviously, if the two boosting voltages be made to assist one another, the total boost will be 18 per cent., whereas if the connections of the primary of the main booster are reversed by means of the change-over switch the boost will be reduced to zero. A Berry three-phase 3000-kilovolt-ampère transformer and hand-regulated booster set, with 300-ampère air brake switches, is shown in Fig. 25, and hand-operated booster regulators for use

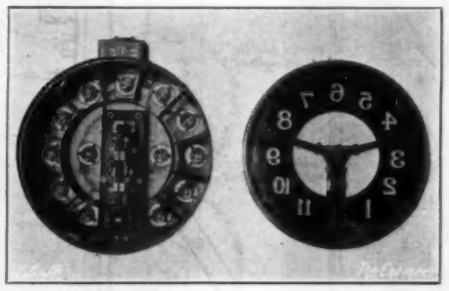


FIG. 33—LAMP AND INDICATOR

on the two-phase side of a 2000-kilovolt-ampère Scott-connected transformer set in Fig. 26. A 7500-kilovolt-ampère 300-ampère booster set with the main transformers in the background in Fig. 27, the regulating switches being of the air-break type.

A diagram of connections for a remote controlled gravity-operated panel for the booster transformer regulating switches, made by the British Electric Transformer Company, is shown in Fig. 29. In order to raise or lower the voltage the operator merely presses a button, as shown at $P B_1$ and $P B_2$. One of these buttons serves for increasing the voltage and the other for decreasing it. Normally, the two contactors C_1 and C_2 are closed in the bottom position, but when the button $P B_1$ is pressed the contactor coil $P C_1$ closes the contactor C_1 in the top position, when the reversible motor A is connected across the line, and it is set into operation. When the button $P B_1$ is released the contactor coil is connected in series with the economy coil E C, which cuts down the contactor coil current to 25 per cent. of its previous value.

Referring now to the drawing Fig. 30, and to the illustrations Figs. 31 and 32, it will be seen that the motor drives a shaft A through gearing, and at one end of this shaft there is an arm carrying a heavy weight G which revolves with the shaft A. After the weight has been lifted through 90 deg. the driving member F, which is attached to the opposite end of the shaft to which the weight is attached, engages with the toothed quadrant D, which is loose on the shaft A. The quadrant, it will be noted, carries a pin E, and after a further travel of 90 deg., when the weight G has reached its top centre, the pin E is ready to engage with the slot H, as shown in Fig. 32. When the weight G is a few degrees over the top dead centre the pin E enters the slot H and gradually accelerates the shaft B until it is rotating at the correct speed for the quadrant D to engage with the wheel J without shock.

The weight then over-runs the motor and moves the switch—which is coupled to the shaft B—through one step, the motor speed being controlled by the diverter resistance D—Fig. 29. The diverter resistance maintains the field strength at a certain value, and therefore prevents the speed becoming excessive. The indicator switch, which is driven by a chain—as shown in Fig. 30—also moves one step and lights an indicating lamp corresponding to that step. Altogether, the shaft B moves through 180 deg., and it is stopped without shock by the pins and slot gear in a similar manner to that in which it is started. Locking gear is also provided. Normally, the shaft B is prevented from turning by the roller M which engages with the locking bar, and is kept in place by the cam

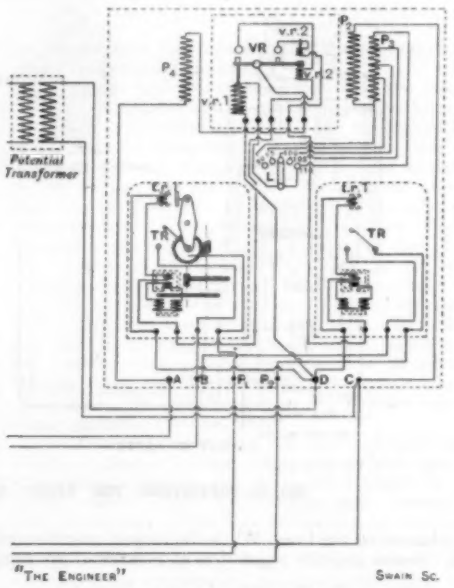


FIG. 34—RELAY CONNECTIONS

N, and is released by the cam when the pin E is on the point of engagement. The actual operation of the transformer tapping switch is performed by the falling weight. Near the conclusion of the stroke the current is cut off by the master switch M S—Fig. 29—thus permitting the contactor to open and the entire mechanism to come to rest. When the other press button $P B_2$ is pressed, and the other contactor C_2 is closed, the motor revolves in the opposite direction and the switch is turned in the opposite sense, but the general operation of the gear is precisely the same as before.

The connections for the motor control panel—Fig. 29—are easily traced. S F is the series field winding of the motor, M B the magnetic blow-out coils of the contactors C_1 and C_2, which are closed by a spring in the bottom position and closed magnetically in the top position; A the reversible motor armature; D the diverter resistance, which, as explained, controls the motor speed when the weight is falling; $P C_1$ and $P C_2$ the pull-in coils operating the contacts C_1 and C_2 respectively; L S the limit switches; M S the master switch which energises the panel; I S the indicator switch which controls the indicator lamps I L, corresponding to the various tappings; W warning lamps; and B a buzzer. Although there is very little chance of the regulator switch coming to rest whilst it is bridging two contacts, it has been deemed advisable to provide warning lamps and a buzzer in accordance with the practice adopted on the makers' ordinary hand-operated regulating switches, so that it is impossible for the switch to be brought to rest during the transition stage without the attendant being aware of the fact.

One of these press button regulating panels is shown on the right of Fig. 28. The three oil-immersed booster-regulating switches, which are operated by the panel, are shown in the middle, and the push button control panel with the indicator lamps on the extreme left. A view of one of these lamp indicators

with the front of the case removed is given in Fig. 33. The two holders for the warning lamps are to be seen in the centre part of the case, whilst the holders for the other lamps are arranged in a circle. The three single-phase oil-immersed regulating switches shown in Fig. 28 have horizontal fixed and moving contacts, but in the case of air-break switches the contacts are mounted on a vertical base.

These regulating panels can be made to work entirely automatically in accordance with the voltage in a very simple and straightforward manner. As shown in Fig. 34, the push buttons are simply replaced by a voltage relay V R and two time lag relays T R. The former closes one of two contacts, according to whether the line pressure is high or low, thereby energising one of the time lag relays T R, which are set to close their contacts after a period of half a minute or so. The contacts on these time lag relays naturally correspond to the push buttons $P B_1$ and $P B_2$ in the diagram, Fig. 29. If the voltage of the system is correct, the lever of the relay V R takes up its horizontal position, whereas if the voltage is high or low the lever is moved out of its horizontal position in the well-known manner, and one or other of the time lag relay circuits is completed.

Engineering Plant at Olympia.

BESIDES the important woodworking machinery exhibits at the Builders' Exhibition which were noticed in our last issue, there was a very large and miscellaneous collection of machinery and plant for builders' requirements. Many of these items are of as much interest to the engineering as to the building industry and are worthy of notice and illustration. Perhaps the most important of them from the engineer's standpoint, and certainly the most comprehensive, were to be found in the display of modern road and building construction plant, such as concrete mixers, stone crushers, screening plant, block-making machinery, &c. No less than twenty-seven firms were showing equipments and plant of this kind, and we can in the space at our disposal refer to relatively few of them.

The largest stand at the Exhibition was occupied by Winget (1924), Ltd., of Warwick, which exhibited a wide range of concrete and allied machinery, amongst them several examples of block and slab-making machines which are well worth the prospective builder's attention. The firm's No. 2 pressure machine for making concrete blocks has been greatly improved in the 1926 model by the provision of an automatic closing and opening of the mould box so that both ends and the front sides are operated together by one action of a handle bar. By this means a great deal of time ordinarily wasted in fixing and removing each end and front separately is saved. The pressure is now increased to 10 tons and is applied by a worm-driven head and the heavy hand wheel shown in Fig. 1. This wheel was formerly at the back, but is now much more conveniently placed at the side. It is claimed that more than 200 blocks can be turned out per hour by this machine.

Another interesting machine is the semi-spiral wet mixer, shown by Fig. 2. It has a narrow drum driven by a Lister engine and its capacity is 4½ cubic feet. It will be observed that the complete unit is carried on rubber tires.

Another Winget machine is the combined clinker, screening and crushing set—Fig. 3—which is very useful for the production of good clinker slabs. In it the clinker is charged on to the grizzly or jigging screen, which screens all material up to ¾in., the rejected stuff being gradually fed into the rolls at the end of the machine. Thus the screen not only extracts the fine material and thus prevents the checking of the rolls, but owing to its jigging action it loosens the material and so presents it to the rolls in the best possible manner. The material when screened is fed by a shoot to the outlet from the rolls in a continuous stream. The output varies from 3 to 10 yards per hour according to the material under operation. Amongst other exhibits on the Winget stand we may mention a screening plant for sand, gravel, clinkers, &c., which is engine driven, portable, self-elevating, and provided with a rotary screen with three different gradings; the Westminster brick machine and a concrete roofing tile machine; and a useful small portable conveyor, suitable for handling bricks, blocks, &c.

Two of their latest types of concrete mixer, of which their model 6/4 possesses an altogether new feature, were shown by John Fowler and Co., Ltd., of Leeds. Both mixers are mounted on road wheels and equipped with side power loaders and automatic water tanks and are driven by petrol-paraffin engines. The drive both from engine to countershaft and countershaft to drum is effected by chains and the power loader is rapidly emptied by means of a vibratory device which does away with the damaging practice of hammering or scraping to remove material which is adhering to the loader. Model 6/4 is illustrated by Fig. 4, which clearly shows the winding drum for the hoist and its method of application to the chassis of the machine. This hoist can be used to hoist loads to the upper storeys of buildings and so on by passing the rope over a fixed pulley. This machine produces 6 yards of concrete per hour and the hoist lifts 10 tons at 50ft. per minute. The engine develops 5 horse-power, which is sufficient to permit the two operations of mixing and hoisting to be carried on simultaneously. The other mixing machine on this stand—10/7—has a capacity of 7 cubic feet and an hourly output of 10 tons.

The principal exhibit on the stand of Builders and Contractors Plant, Ltd., London, was the "Exe" hoist, which is virtually a vertical light line railway, up and down which runs a horizontal lifting platform—see Fig. 5. On this platform the load is placed. For example, a loaded barrow can be wheeled on to it and hoisted to the top where, it is received by a pivoted head, whence the loaded platform is swung round to the desired position and the barrow wheeled off to wherever the material is required. The platform takes a load of 10 cwt. and travels at 200ft. per minute. In addition to this arrangement a jib can be

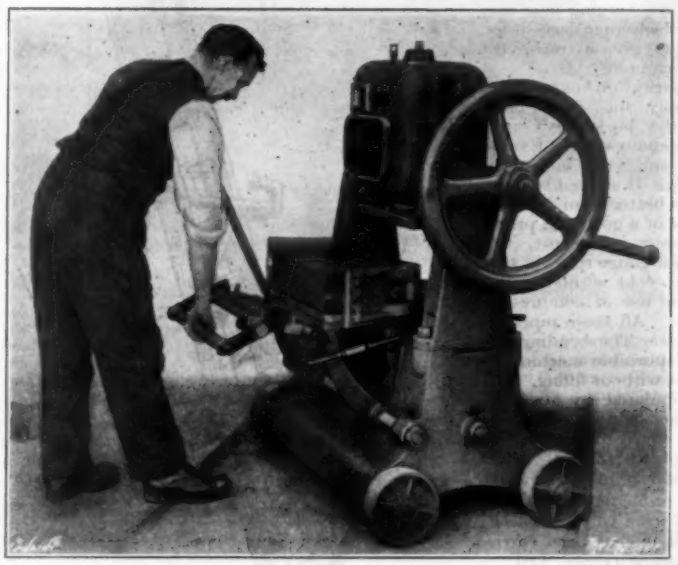


FIG. 1—CONCRETE BLOCK-MAKING MACHINE—WINGET

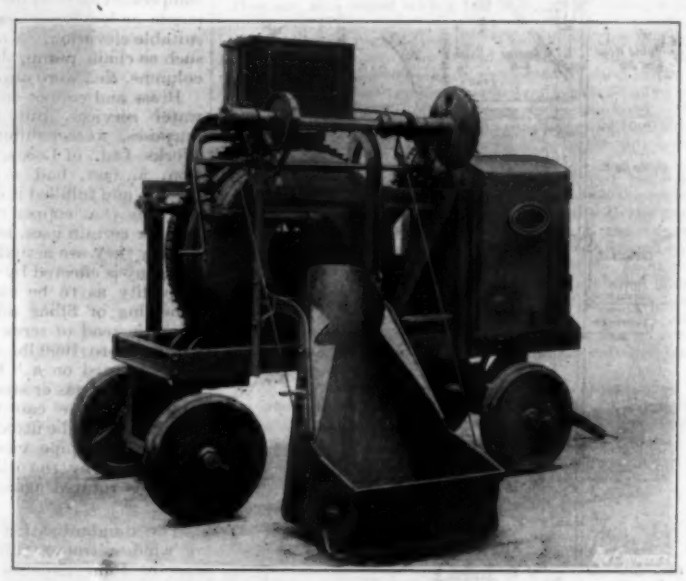


FIG. 2—SEMI-SPIRAL CONCRETE MIXER—WINGET

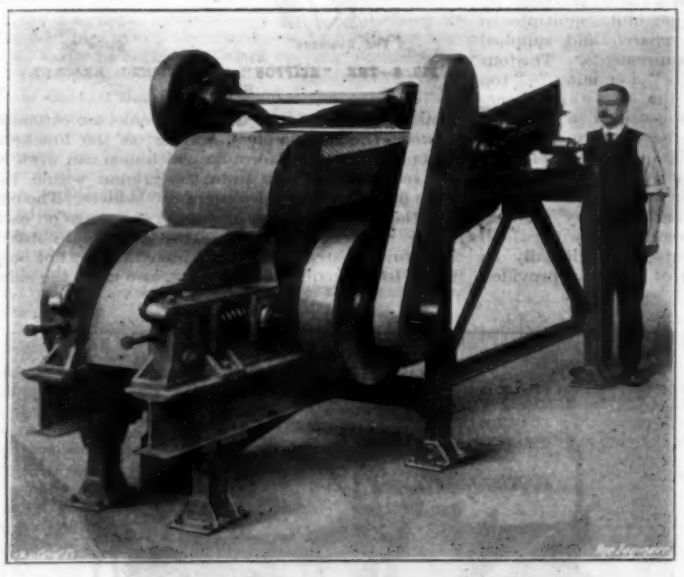


FIG. 3—COMBINED SCREENING AND CRUSHING PLANT—WINGET

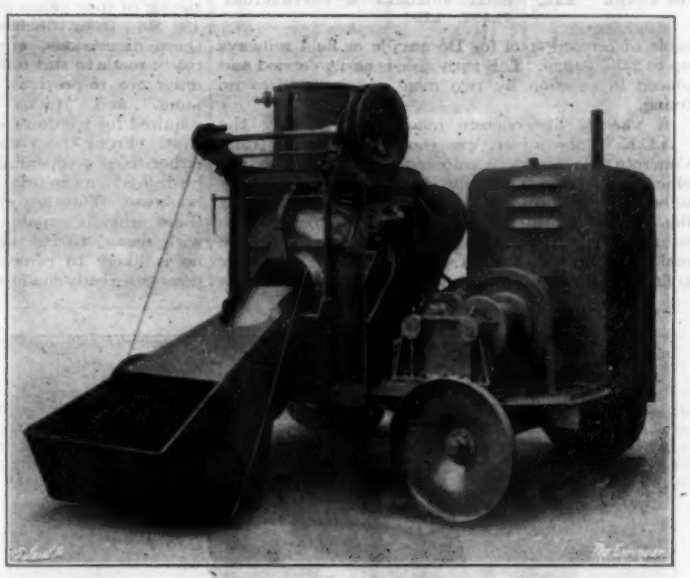


FIG. 4—CONCRETE MIXER—FOWLER

fixed to the swinging head, as shown in the drawing. This jib is designed to take a load of 30 cwt. and may be used for hoisting materials and for lifting and adjusting scaffolding, joists, &c. The hoist is very compact and can be fixed to ordinary scaffolding and extended to any reasonable height. The winch is constructed with a view to minimising shock due to variation in loads and is fitted with an efficient brake counterweighted to hold the load at any point.

The same firm, among other exhibits, showed its portable "Roll" concrete mixer for ordinary street work. The mixer has no paddles, the mixing being effected by centrifugal force and gravity only. The frame is constructed so that the discharge can be effected at varying heights for barrow, truck, or lorry loading. Another useful item was a portable turn-

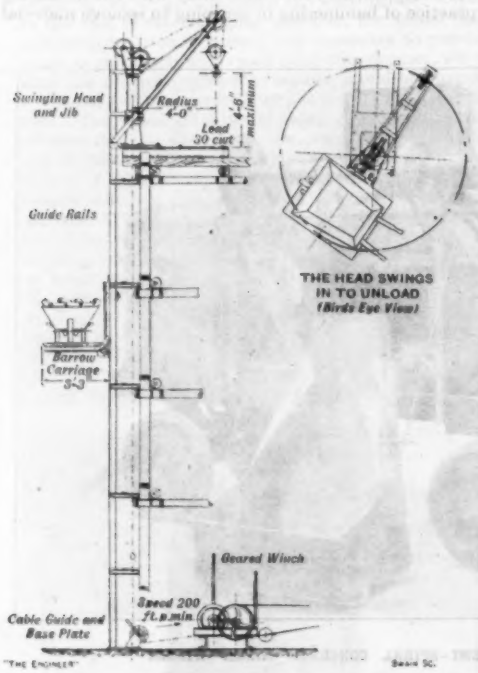


FIG. 5—THE "EXE," HOIST—BUILDERS' & CONTRACTORS' PLANT, LTD.

table of pressed steel for Decauville or field railways up to 24in. gauge. This turntable is easily carried and placed in position by two men and it requires no fixing.

A variety of concrete machinery, notably the "A.C.E." cube mixer, was shown by the Australia Concrete Machinery Company, of London. The chief feature in this machine is that the drum, instead of being in the form of a circular cone, has a number of flat sides which throw the aggregate from one surface to another with a zig-zag movement which, the makers claim, produces a perfect mix. This mixer is fitted with wheels and can be mounted on a chassis with its own engine and a drum for hoisting. It is made in sizes with capacities varying from 3 to 21 cubic feet. A small handy machine shown by this company is the "Tonkin" mixer, capacity 3 to 4 cubic feet. It is a portable batch mixer of the open drum type. On the axle are fixed steel arms set at varying angles to the end of which is fixed a row of steel rakes which work the aggregate from ends to centre and centre to ends, thus ensuring a perfect mixture. Not only is this machine useful for concrete mixing, but also for mixing mortar, tar-macadam, asbestos, fibre composition, &c. Amongst other exhibits on this stand we noted automatic block and brick-making machines which are particularly intended for small house building schemes.

A stand which attracted a good deal of attention was that of Tuke and Bell, of Lichfield, who were showing some interesting sewage purification plant consisting of a patented "Ideal" revolving distributor worked by automatic tippers in a central container. This method is claimed by the firm to be better than the usual dosing syphon, on account of its positive action and the absence of perforations which are likely to be choked. The firm exhibited a water pressure filter for country houses, &c., with all the necessary valves and appliances for cleansing the filtering material, and a pneumatic ejector with automatic control gear for the admission and exhaust of compressed air used for lifting crude sewage from basements or low-lying sewers and discharging it at any suitable elevation. A number of sewerage accessories, such as chain pump, sludge plugs, grease traps, vent columns, &c., were also to be seen here.

Brass and copper tubes primarily for hot and cold water services, but incidentally for many other purposes, were exhibited by the Yorkshire Copper Works, Ltd., of Leeds. The company at this Exhibition, in fact, had a distinct and very interesting mission and fulfilled it effectively. It was out to show, not only that copper tubes are better than iron and lead for certain uses, but that if of a good and proper quality they are actually cheaper in initial cost. The economy is effected by using light gauge tubes of such a quality as to be easily bent cold without either annealing or filling and by the use of compression joints instead of screwed joints. All these pipes are subjected to 1000 lb. water test. The bending was demonstrated on a "Hilmor" portable machine for cold bending gas or steam tubes, without filling. This simple machine can be manipulated by unskilled labour and can be fitted to a bench held in an ordinary vice or in a pipe vice. The curve of the bend is determined by the diameter of a "former" wheel which is rotated against a guide by means of a bar lever.

The standardisation of units from which a variety of window frames can be built up has been carried far by John Thompson Beacon Windows, Ltd., of Wolverhampton, on the stand of which the pratice was very ably and completely demonstrated. The principle starts from the use of four basic units, each consisting of four panes of glass in a frame 2ft. 0⅞in. by 1ft. 8in., from which eight larger units, multiples of these dimensions, are also prepared and supplied ready made to suit different requirements. The four units are respectively "fast," "side hung," "top hung," and "pivot hung," the last three being required for windows which are destined to open and shut. From these units can be built up windows either fixed or opening to any dimension which may be desired on the principle, as it were, of the expand-bookcase. Thus any contractor who chooses to stock these units is capable of coping with any problem with regard to lighting and ventilation with which he is likely to come into contact, as virtually he possesses ready-made windows of any size, provided that it is a multiple of the original unit. He has the option of hanging his windows in three different ways to suit the conditions, and he can have as large an area as he likes of fixed or opening windows.

One of the simplest and yet a very interesting and practical novelty in this Exhibition was the patented scaffolding bracket "Klippon" shown and demonstrated by P. E. Helme and Co., of London. Primarily intended as a rough-and-ready substitute for light scaffolding for the use of builders, it would be of equal use to engineers when doing work at a height from the ground where permanent or more substantial tackle is not available. Our illustration shows this accessory very clearly. To utilise it two ordinary ladders are needed. To each of these ladders a "Klippon" bracket is fitted, and its function is to provide a seating or support for one, two, or three planks, as the case may be. The planks are extended between the two ladders, resting on the brackets, thus providing a platform on which men can work at any required distance from the ground within the scope provided by the length of the ladders. The one essential is that the space between the rungs on each ladder shall be identical. The "Klippon" takes the form of a steel bracket so shaped that it not only fits on to the required rungs, but also grips the sides of the ladders, thus affording far more security than would be the case if the weight of the platform and the men were to be borne entirely by the rungs. The actual shape of the brackets depends on whether they are intended to support one or two boards. For a three-board platform two brackets are required on each ladder, arranged as shown on the lower part of Fig. 6. The widths of the platforms are 11in., 22in., and 36in. respectively.

FIG. 6—THE "KLIPPON" SCAFFOLDING BRACKET—HELME

FIG. 7—HYDRAULIC CONCRETE BLOCK-MAKING MACHINE—STOTHERT AND PITT

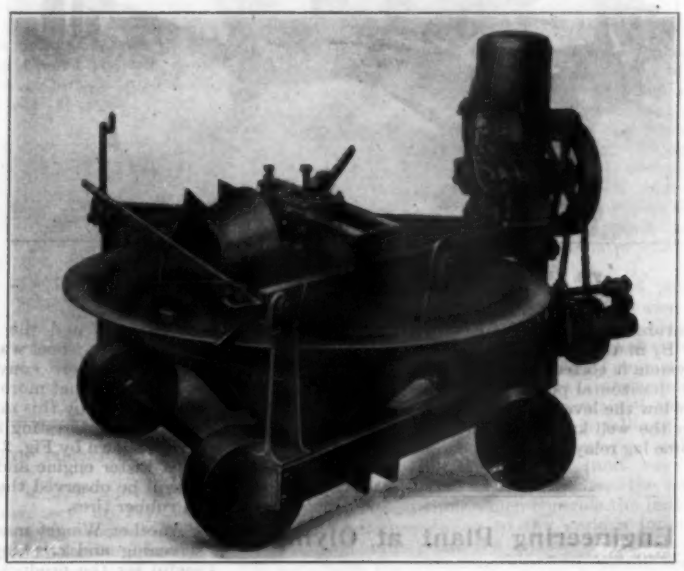


FIG. 8—EDGE-RUNNER MORTAR MILL—STOTHERT AND PITT

Among other exhibits, Thomas and Bishop, Ltd., of London, demonstrated the virtues of "Cling Surface," a preparation for belt dressing. The difference in efficiency between belts treated and untreated with "Cling Surface" was shown in a practical way on running pulleys. It is claimed that not only is efficiency in power transmission increased, but that the life of a belt is materially prolonged, as the "Cling Surface" gradually penetrates through the belt, keeping it pliable and proof against weather effects. It can be used on any kind of belting or driving rope and should be applied at a temperature of not less than 60 deg. Fah., as below that point it is not fluid enough for application.

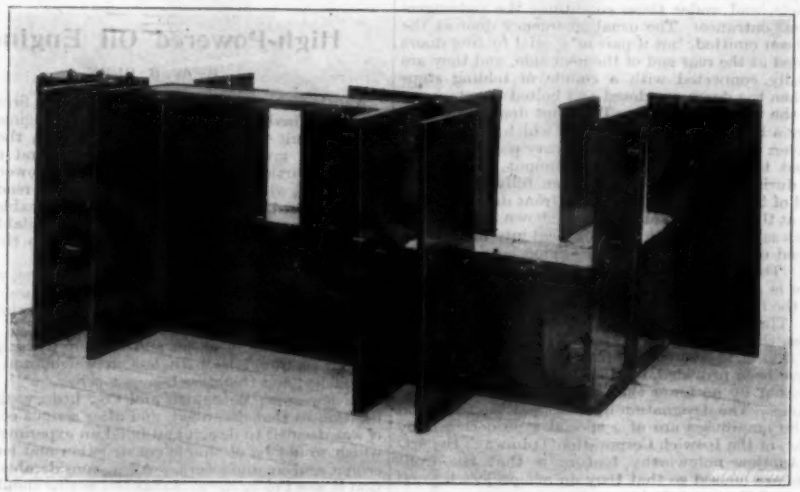


FIG. 9—"CONFORMS" STEEL SHUTTERING—SCAFFOLDING (GREAT BRITAIN), LTD.

The main exhibit on the stand of Stothert and Pitt, Ltd., of Bath, was a new hydraulic block and brick moulding machine which we illustrate by Fig. 7, and a Stothert mortar mill, Fig. 8. New points about the former are that it requires no accumulator or tank, and is not dependent on a local water supply; for plain blocks the moulding blocks are not collapsible, so perfectly clean corners are obtainable. There is a simple hydraulic apparatus for ejecting the finished blocks and the amount of hydraulic pressure may easily be regulated to suit varying requirements.

The mortar mill is of the "edge-runner" type. It is claimed that in this machine the disadvantages in the way of caking the material in the pan and the consequent non-crushing of some of the lumps are entirely avoided. This is done by suppressing the flat bottom and vertical sides of the ordinary pan and replacing them with a pan with sloping sides, producing a conical roll. A strong point of this machine is that the larger side of the roll is towards the centre of the pan, which creates a maximum of differential speed between the surface of the pan and the roll, and promotes disintegration thus facilitating fine grinding.

Tubular scaffolding, "Scaffix" scaffolding ties, heavy and light suspended scaffolds, "Conforms" stamp steel shuttering and adjustable stanchion plates were shown by Scaffolding (Great Britain), Ltd., of London. Periodical interesting demonstrations were given showing the advantages to be gained by the use of tubular scaffolding with sprocketed steel tubes, universal couplers and reinforced putlogs, the use of which obviates all putlog holes. The application of suspended scaffolds and scaffold ties was also demonstrated. In these days, when the adaptability of concrete for almost any form of building is fully appreciated and becoming more and more popular, the application of the firm's patented adjustable stanchion plates is an interesting matter. These can be adapted to any dimension of column or pilaster, automatically squared and plumbed as they are placed in position, easily assembled and dismounted, and are self-supporting. Fig. 9 is a sample lay-out of these "Conforms" showing the provisions for effecting the various angles required in a concrete wall.

Electric Trolley Omnibuses at Ipswich.

SOME two or three years ago the Ipswich Corporation was faced with the necessity of either having to embark upon an expensive scheme of the relaying practically the whole of the permanent way of the electric tramway or of adopting some other form of transport in the town. In a report prepared for the Corporation it was shown that, in the past, the tramways had never been really remunerative and that the heavy expenditure which the work of relaying the permanent way would entail would make the financial position of the undertaking still less favourable. The question of employing petrol or electric trolley omnibuses was therefore considered, and, on the score of economy in operating costs, it was deemed advisable to replace the electric tramcars by electric trolley omnibuses. Before coming to a definite conclusion with regard to the matter, however, it was thought advisable to give the trolley omnibuses a trial on a short section of the system, having a length of about two-thirds of a mile, between the Cornhill, the centre of the town, and the railway station, this section having been worked for years with a shuttle service. Three electric trolley omnibuses were accordingly hired from Railless, Ltd., and after a few months' use they were purchased, for they soon demonstrated that they were eminently suited for the work.

The Corporation then decided to apply for parliamentary power to change over the system, and following the statutory requirements a town's meeting was held to obtain the approval of the inhabitants. Although the proposal met with a certain amount of opposition, the necessary majority of votes in favour of the change was obtained without difficulty, and in due course the Bill passed through both Houses.

Having secured the necessary statutory authority last year, the Corporation decided to embark upon the larger scheme of scrapping the tramways in sections, and an order was placed for thirty electric trolley omnibuses. Prior to this stage being reached, however, another trial was made on another section of the tramway system, namely, that between the Cornhill and the Wherstead-road terminus, and for that purpose Ransomes, Sims and Jefferies, Ltd., supplied an electric trolley omnibus designed on new lines. Later trials were also made with vehicles lent by Tilling Stevens, Garrett, and Ransomes. As the result of inviting tenders for thirty vehicles for the scheme in the eastern district of the town, Ransomes, Sims and Jefferies and Garrett's, of Leiston, were each awarded an order for fifteen trolley omnibuses. Seven of these vehicles, as shown in Fig. 1, which incorporate some novel features, have already been delivered by Ransomes, Sims and Jefferies. The weight of the complete chassis of the vehicles built by this firm—see Figs. 2 and 3—is 3½ tons, whilst the weight of the complete vehicle ready for the road is 5 tons 12 cwt. The maximum speed with full load on the level is 22 miles per hour, whilst the speed when fully laden on the route known as Bishop's Hill—a long, steep hill on which the maximum gradient is 1 in 11, is 12 miles per hour. All the vehicles are tested on the route known as the Wherstead route, over which we recently had an opportunity of travelling in one of the Ransomes, Sims and Jefferies electric trolley omnibuses. They are also tested with a full load on the Bishop's Hill route, one of the tests being to stop and start the vehicle on the steepest part of the hill. When descending Bishop's Hill the brakes are also tested whilst the vehicles are fully loaded. The brakes are very powerful, and either of them will stop the vehicle when travelling at 20 miles per hour with full load in 16 to 20 yards on the level. The normal rating of the motor is 50 horse-power at 1000 revolutions per minute, and each motor is tested up to 100 horse-power.

A straight series type controller is employed, the main drum of which is worked by a foot pedal while the reversing drum which is mechanically interlocked with the main drum, is operated by a lever on one side of the driver's seat. A dial on the dashboard has a pointer connected with the controller and indicates the position of the main controller at any moment. Power from the motor is transmitted to the back axle by a steel tubular propeller shaft provided with enclosed universal joints at each end, and the couplings of these joints where attached to the motor shaft and to the worm shaft on the axle are provided with splines.

The back axle consists of a forged steel casing dished in the centre to receive the worm wheel differential and the worm unit, which is mounted on the cover that closes the dished space in the centre of the axle. At each end of the axle there is a massive steel bracket which carries the extra large brake shoes and their cams. Each rear wheel has two separate brake drums composed of pressed steel and the rear wheels and those at the front of the vehicle are of the hollow spoke type cast in steel. The rear wheels

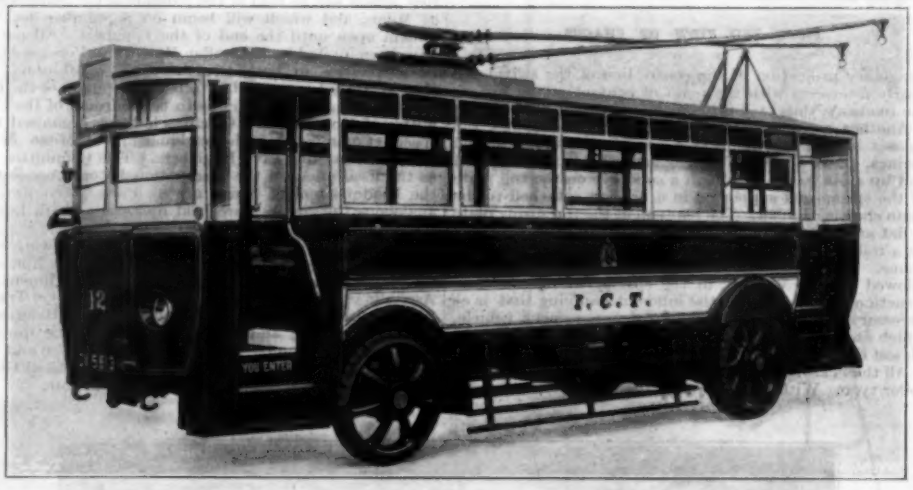


FIG. 1—ELECTRIC TROLLEY OMNIBUS—RANSOMES, SIMS AND JEFFERIES

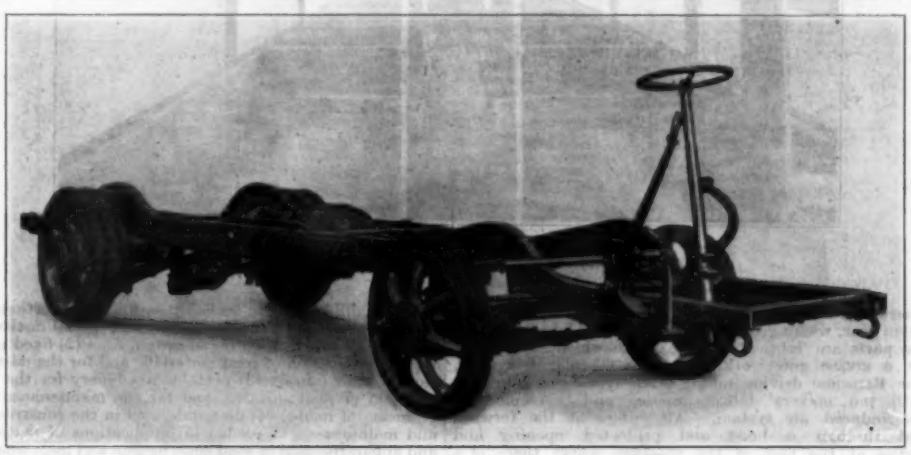


FIG. 2—CHASSIS FOR ELECTRIC TROLLEY OMNIBUS

are fitted with twin 850 by 120 solid tires, whilst each front wheel is fitted with 771 by 140 tires. The brake system, which is very effective, is operated by compressed air, the equipment having been supplied by the British Air Brake Company. The Reavell compressor and the Ransome motor which drives it are mounted on the

rear side of the chassis. The rotary compressor is of an entirely new design and is a remarkably small unit. Its motor is controlled by an automatic switch operated by a piston in a cylinder which is controlled by the pressure in the brake cylinder fixed on the opposite side of the chassis to that on which the compressor is placed. The working limits of air pressure in the reservoir are 30 lb. to 40 lb. When the pressure in the reservoir drops to the latter value the compressor starts automatically and when the pressure reaches 40 lb. per square inch the automatic switch, which is situated in the driver's cab, automatically switches off the current to the motor. To apply the brake the driver merely brings into play a foot-operated valve, which, when depressed, causes air to enter the pipe leading from the valve to the brake-operating diaphragm boxes. There is also a hand-operated brake which is used for emergencies and for holding the vehicle when it is standing.

The front axle consists of a drop forging composed of special steel. The stub axles are so arranged that an

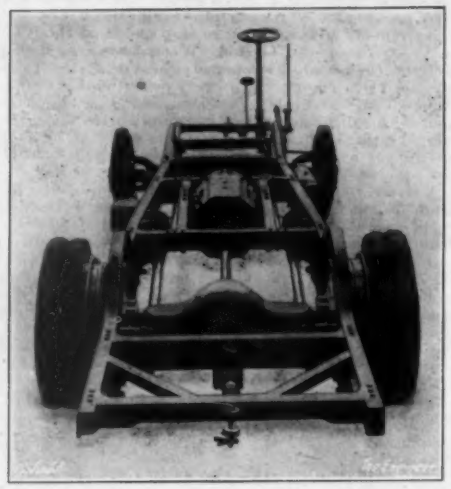


FIG. 3—END VIEW OF CHASSIS

imaginary projection of the centre line of the swivel pin nearly intersects with the point of contact of the tire on the roadway, thus facilitating easy steering.

Another notable feature of these vehicles is that the chassis is well sprung by the use of specially designed springs. Each spring is 5ft. long and is held at the forward end by a pin passing through a solid eye on the top plate of the spring and supported in a bracket attached to the main chassis member. The rear end of the top spring plate is flat and has a wearing piece attached to it, which bears on a roller supported in a bracket attached to the chassis frame. The maximum amount of freedom is therefore allowed for the working of the spring, the special construction of which gives the inherent damping that is so necessary for the smooth riding of a passenger vehicle, which at one moment may be fully loaded and at another almost empty.

All the bearings, including those of the motor, are of the roller type. With the exception of the naves of the front wheels and the dished part of the back axle containing the worm gear, where provision is made for oil lubrication, all the parts are lubricated with grease which is supplied by a grease gun working on the Tecalemit system. The Ransome driving motor is designed in accordance with the makers' latest practice and is cooled on the induced air system. Air enters at the forward end through a hood and protected opening and leaves at the rear of the machine, where there is a somewhat different form of hood which prevents water entering the motor when the vehicle is being washed. By simply removing eight bolts the motor can be dropped from the chassis frame for overhaul or replacement. The armature can, moreover, easily be removed from the motor without detaching the carcase of the machine from the chassis framing; the only work entailed being that of disconnecting the propelling shaft and of taking off one of the motor end covers.

The bodies of these new vehicles are also designed on somewhat special lines, and doors are provided at the front and rear. The position of the former door is in front of the near side wheel, thus enabling part of the space usually taken up by the driver's cab to be utilised, and when the vehicles are operated by a single man the driver can receive the passengers' fares and issue tickets without difficulty. During the slack periods of the day this practice of placing the vehicles in charge of one man is adopted, but during the busy periods a conductor and driver are employed on each vehicle, and under these conditions the passengers use the rear entrance. The usual emergency door at the rear has been omitted, but a pair of special folding doors are provided at the rear end of the near side, and they are mechanically connected with a couple of folding steps so that when the doors are closed and bolted the steps are folded in the upright position. The front door is made to fold up by a lever placed in a position which is accessible to the driver. Each vehicle will seat thirty passengers and is designed to give the maximum amount of standing capacity during the rush hours. When fully loaded the floor level of the vehicle is 29in. at the front door entrance and 33in. at the rear door entrance. As shown in Fig. 4, the single-deck saloon type bodies have a neat interior appearance, fumed oak and white enamel having been used as a contrast. The seats are upholstered in green leather cloth and space is provided between the near side longitudinal seat and the front door for a small quantity of passengers' luggage. The driver is completely screened off from the passengers, there being a separate door to his cabin at the front off side of the vehicle. Excellent lighting arrangements have been provided, for the interior of each vehicle is illuminated by no fewer than eleven ceiling-type bulkhead fittings. The designation indicators at the front and rear of the omnibuses are of a special type designed by Mr. Clarke, of the Ipswich Corporation Tramways Department. Another noteworthy feature is that the front headlights are housed so that they do not project beyond the surface of the front dash.

FIG. 4—INTERIOR OF ELECTRIC TROLLEY OMNIBUS

INTERNATIONAL ROAD CONGRESS AND EXHIBITION.

An International Road Congress is to be opened at Milan on September 6th next, and concluded at Rome. Concurrently there is to be an International Road Exhibition, which will be held in the grounds of the Sample Fair, at Milan, and which will begin on September 1st and remain open until the end of the Congress. All nations have been invited by the Italian Ministry of Foreign Affairs to participate in both Congress and Exhibition. The King of Italy has consented to become Patron of the Congress, and Signor Mussolini is to be chairman of the Committee of Honour. The Congress is being organised by a special Commission with headquarters at Milan in the offices of the State Civil Engineers. This Committee acts as the local organ of the International Road Association, the headquarters of which are at Paris. The previous analogous Congresses were held in Paris and in London before the war, and at Seville after the war.

The Congress will deal chiefly with the following :—(*a*) Concrete Roads; (*b*) Bituminous and Asphalt Surfaces; (*c*) Standardisation of Tests for Coal Tar, Bitumens and Asphalts used in Road Construction; (*d*) Census of Traffic; (*e*) Development and Planning of Towns in Relation to Traffic Interests; and (*f*) Motor Roads. The Congress will probably assemble in the Castello Sforzesco and hold its sittings in the large building of the Facoltà di Giurisprudenza, which is not far from the Sample Fair.

The Exhibition is to include the following sections :—(1) Public administrations, corporations, special institutes, propaganda and touring organisation, &c.; (2) fixed plant for the production of road materials, and for the destruction of road refuse; (3) portable machinery for the preparation of road surfaces, and for the maintenance and cleansing of roads; (4) materials used in the construction and maintenance of roads; (5) applications of materials and apparatus used in road construction and maintenance, such as: wood blocks, concrete, macadams, pavements; road accessories, such as hydrants and tampers; and street lighting; (6) vehicle parts and accessories such as rims and types of tires; suspensions; shock absorbers; brakes; lights; hooters, &c.; speed and stop indicators; anti-splash devices and contrivances to prevent the raising of dust; and buffers; (7) tramways—foundations, pavements and rails—overhead lines in relation to the street; (8) motor omnibuses for town and country roads; (9) indicators for road traffic—sign-posts, safety devices for level crossings, methods of regulating traffic in crowded cities; (10) measuring and testing apparatus; (11) road evolution; and (12) the Press and the road.

Further particulars of both Congress and Exhibition may be obtained on application to On^le Comitato Ordinatore della Mostra Internazionale della Strada, Via Sala 3, Milan (3), Italy.

High-Powered Oil Engines.*

By W. S. BURN.

About two years ago marine engineering firms who had not specialised in the manufacture of oil engines were in a very difficult position. On the one hand, there was an undoubted growing demand for cheap and reliable oil engines, particularly for those of high power. On the other hand, whilst a reliable engine could be readily enough manufactured, its production at a reasonable cost was almost impossible with the works plant available.

There were two alternative solutions to the problem, viz.:—

(1) To take a proven and reliable engine, say, of the four-stroke single-acting type and to reduce the manufacturing costs by special works organisation and the extensive use of special jigs and tools.

(2) To go boldly ahead and develop a cheaper type, a type that would be both less in weight and of greater simplicity, and therefore less cost *per se*.

Richardsons, Westgarth and Co., Ltd., were in such a position as that described, and after serious consideration it was decided to design and build an experimental engine which would be of simple construction and lend itself to economical manufacture. After considerable investigation it was finally decided that the engine should be of the double-acting two-stroke type with port scavenging, working with a moderate compression pressure and employing the solid-injection controlled-pump system of fuel injection. The engine—see drawing Fig. 2—has now been designed and built, and the chief object of this paper is to describe its construction and performance.

For experimental purposes it was decided to construct only a single-cylinder unit, but to make all parts such that they could be embodied in a four-cylinder engine. It was further decided that all items such as the fuel pump, control gear and other gear, should be made full size as a test of design and manufacture in order that a full-size engine could afterwards be constructed with confidence. The photograph reproduced in Fig. 1 shows the experimental engine and Fig. 3 the control gear.

The design particulars of the standard Richardsons-Westgarth engine are as follows :—

Diameter of cylinder	26½in. or 680 mm.
Stroke	47¼in. or 1200 mm.
Stroke-bore ratio	1·765
Revolutions per minute	90
Piston speed	710ft. per minute
Brake horse-power per cylinder	800
Brake mean effective pressure	70 lb. per sq. in.

From this size of cylinder powers varying from 2000 to 10,000 brake horse-power with from three to nine cylinders and speeds of 90 and 125 revolutions per minute will be obtainable. The cylinder is of reasonable dimensions and the working parts are of such a size and weight as to be readily handled. An engine suitable for a moderate-sized tramp or general cargo liner will have only three or four cylinders.

The weights of three, four, and six-cylinder engines have been computed from the actual weights of the experimental engine and are as tabulated below :—

	Including fly-wheel, thrust block and after bed-plate. Tons.	Lb. B.H.P.	Excluding fly-wheel, thrust block and after bed-plate. Tons.	Lb. B.H.P.
3 cyl., 2400 B.H.P., at 90 r.p.m.	185	172	155	145
4 cyl., 3200 B.H.P., at 90 r.p.m.	250	175	220	155
6 cyl., 4800 B.H.P., at 90 r.p.m.	340	159	310	145
6 cyl., 6650 B.H.P., at 125 r.p.m.	340	115	310	105

In order that fair comparisons may be made, weights have been given with and without the after gear comprising the fly-wheel, thrust block and after bed-plate.

General Construction.—The bed-plate, columns and crank case call for no special remarks except that a strong yet simple construction has been aimed at. It will be noted that the bed-plate is of the tank top type and that long tie bolts serve to connect the cylinders and columns to the bed-plate and incidentally serve as main bearing bolts. Oil joints in the bed-plate have been practically eliminated. Fig. 2 illustrates the general construction of the engine.

The crank shaft is of the built-up type and has a journal diameter of 18¼in., which size is also suitable for five and six-cylinder engines. The bearing pressures are such as to conform with the latest oil engine practice, as can be seen from the following table :—

	Cyl. area (at 550 lb. per sq. in.). Bearing diameter × length. Neglecting inertia.	Including inertia.
Top ends	1300	960 lb. per sq. in.
Bottom ends	1000	738 lb. per sq. in.
Main bearings	490	360 lb. per sq. in.

Lubricating oil is distributed to the bearings by the orthodox forced lubrication method. The guides are of the ordinary single-guided type with a white-metalled shoe without water cooling.

Cylinder Parts.—In any oil engine and particularly if of the two-stroke type the cylinder parts are subjected to the most strenuous usage of any part and particularly the cylinder liner. It is therefore only logical that these parts should receive the primary consideration.

The Richardsons-Westgarth cylinder construction is designed to satisfy three basic principles, viz.:—

(1) All those parts subjected to heat stresses are designed as far as possible so that the heat and mechanical stress are a minimum.

(2) The port scavenging system is such as to be inde-

* North-East Coast Institution of Engineers and Shipbuilders.—Abridged.

A NEW DOUBLE-ACTING TWO-CYCLE MARINE OIL ENGINE

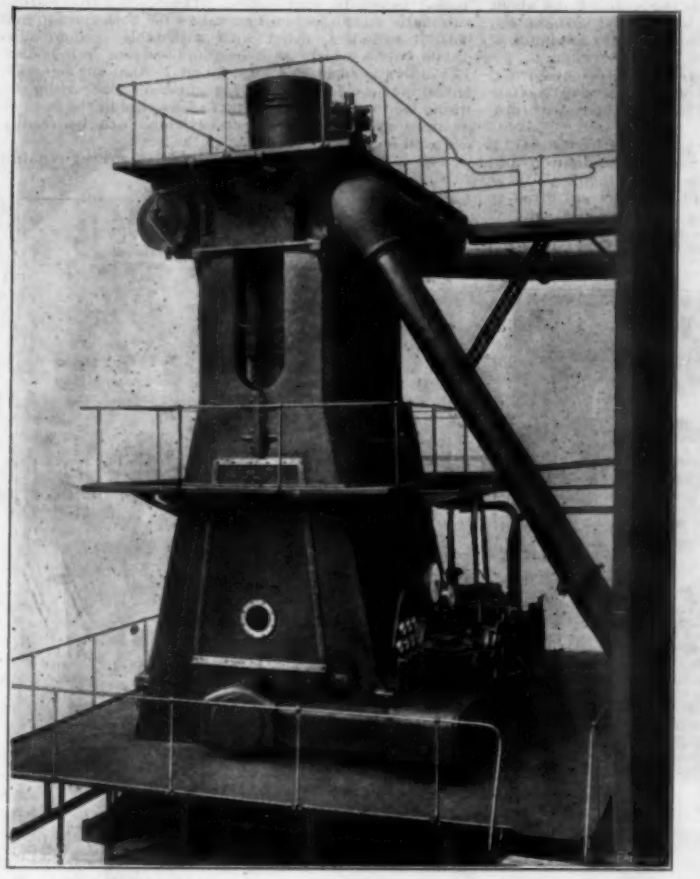


FIG. 1—VIEW OF THE EXPERIMENTAL UNIT

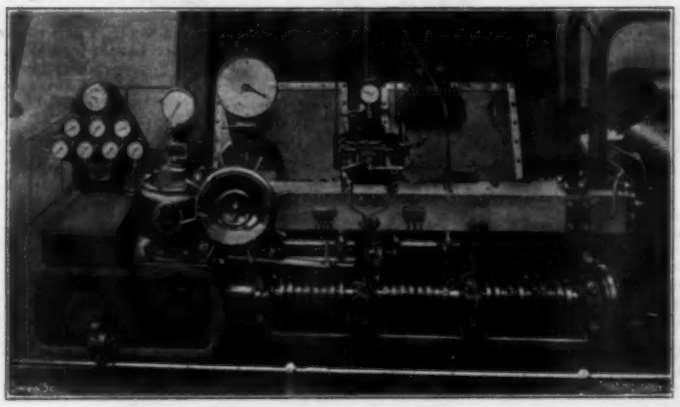


FIG. 3—ENGINE CONTACT UNIT

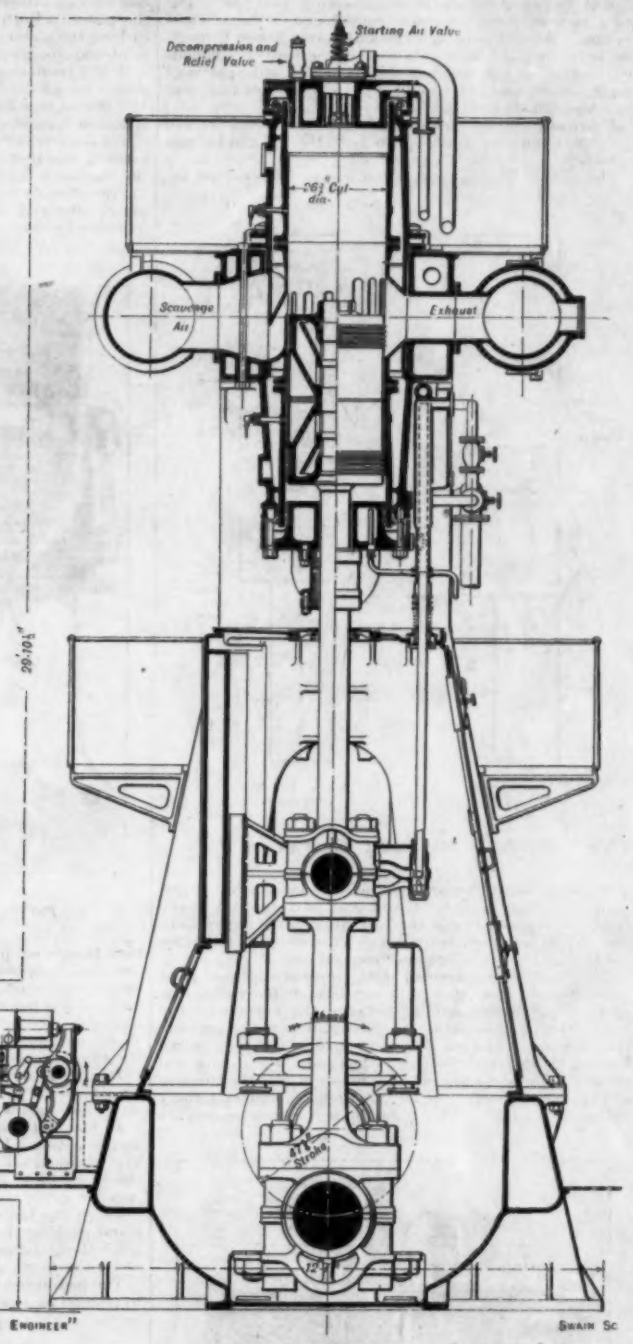


FIG. 2—VERTICAL SECTION

pendent of the piston and cylinder cover, so that these parts can be designed with reference to their own specific functions.

(3) The upper and lower cylinder ends are of identical construction and the covers and valves interchangeable, thus reducing cost of manufacture.

Cylinders.—Reference to drawing Fig. 2 and the engravings Figs. 7, 8, and 9 will show the general design of the cylinder. Each cylinder casing is separate and held to the columns by four tie-rods. An ample scavenge air receiver is embodied in the scavenge side of the cylinder, whilst the exhaust half of the casing is water cooled. The casings are bolted together and to the columns to form with the bedplate a rigid girder construction.

Cylinder Liner.—The liner is held at the centre at the scavenge and exhaust belt by the upper cylinder jacket in such a manner that all grooves and rubber rings are dispensed with and both ends left free to expand axially or diametrically. The design is such that the exhaust and scavenge belt can be made of specially robust design, as the outside diameter of the belt need not be restricted to pass through the cylinder end as in the ordinary two-stroke, which has a spigot joint at the top end of the liner. It is therefore possible to make within the depth of the scavenge belt a number of specially formed scavenge nozzles which have their outlets as ports in the cylinder.

From foundry considerations the scavenge and exhaust belt is a separate casting bolted to the two simple end liners, which are made of a specially tough mixture. All complication is therefore confined to a comparatively small casting which is only subjected to low heat and mechanical stresses.

The chief feature of the liner—see Fig. 9—is the patented alternate scavenge ports which enable true port scavenge to be used for both top and bottom cylinders with a minimum length of liner and yet an ample port area. The nozzle ports are such that the scavenging can be accomplished quite independently of the shape of the piston ends, and they are separate for the top and bottom cylinders.

Before commencing the construction of the experimental engine the scavenge system was tested in model glass cylinders and sufficient indication of the performance was obtained to warrant proceeding with the experimental engine. Unfortunately, a satisfactory photograph could not be taken to demonstrate the flow from the ports throughout the cylinder, but diagram Fig. 5 gives an idea of the results obtained. When the scavenge port is only partially opened the side of the piston forms part of the scavenge nozzle and directs the air almost vertically upward, the line of flow falling as the port is opened, so giving an efficient scavenging action.

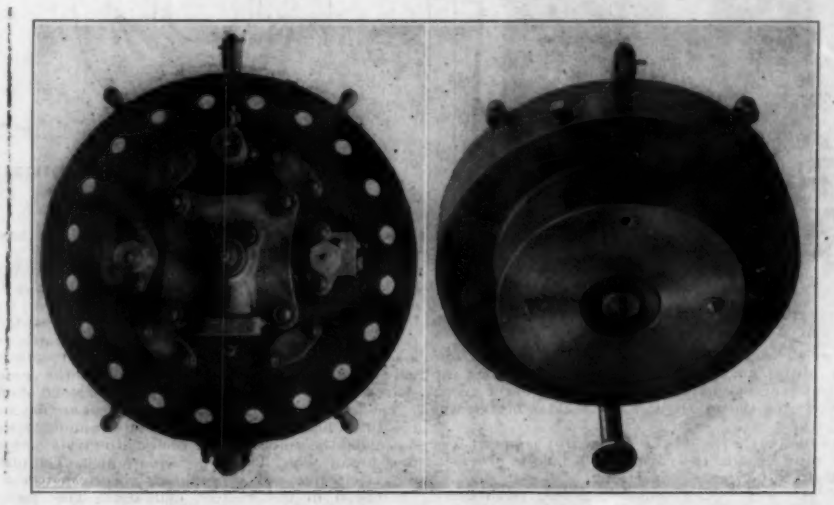


FIG. 4—UPPER AND LOWER SIDES OF TOP CYLINDER COVER

The length of the exhaust ports is made such that the upper portion exposed to gases from the upper cylinder is never exposed to the gases from the lower cylinder, and *vice versâ*, so that lubrication about the exhaust ports should be as good as in single-acting practice. The exhaust port bars are water cooled and of large cross section. As all the cylinder cooling water passes through the bars, they are kept at a low temperature corresponding to that at the scavenge side, which is only partially water cooled, and that should ensure an equable temperature throughout the belt.

Lubrication of the piston and liner is effected by five feed holes at about mid-height of both the top and bottom cylinders.

The ends of the liner where the stresses are greatest are

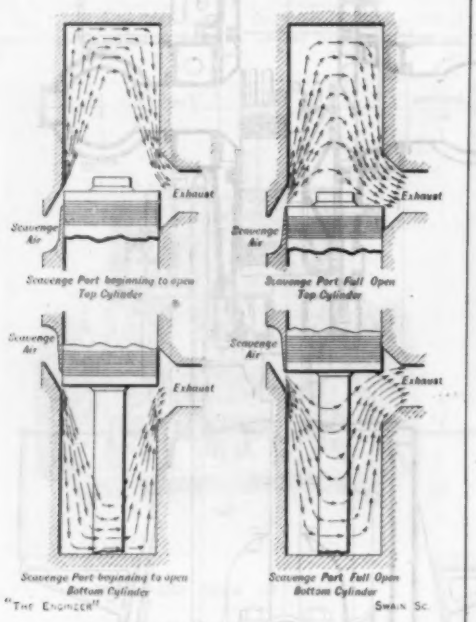

Exhaust
Scavenge Air
Scavenge Port beginning to open Top Cylinder
Scavenge Port Full Open Top Cylinder
Scavenge Port beginning to open Bottom Cylinder
Scavenge Port Full Open Bottom Cylinder
"The Engineer"
Swain Sc.

FIG. 5—SCAVENGING DIAGRAM

quite plain and of minimum thickness because no spigot joint need be provided for, and that part exposed to the combustion pressure and temperature is some inches from the end of the liner, being therefore somewhat strengthened. The liner ends are machined all over.

Cylinder Covers.—Instead of the ordinary form of joint—see Fig. 4—the cover joint consists of five well-fitting spring rings fitting axially between the cover and the liner. With this construction the area exposed to pressure is a minimum, and, as the cover does not require initial loading on the studs to form a gas joint, the mechanical stresses induced should be a minimum, whilst the freedom of expansion afforded in all directions should materially reduce heat stresses. Both the top and bottom covers are

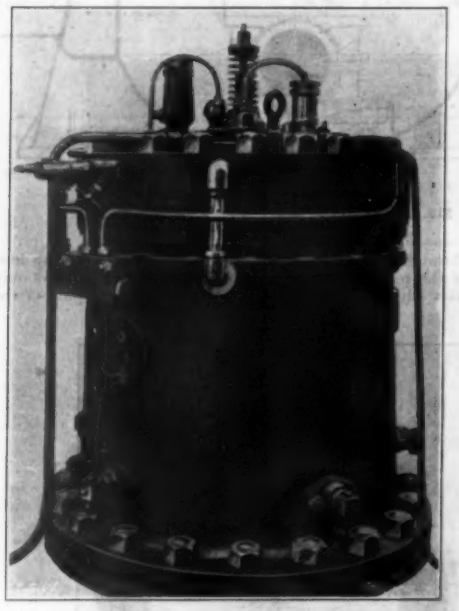


FIG. 6—TOP COVER AND CASING

identical in all respects and are of a ribless construction with one central hole to accommodate the starting air valve in the top cover and the piston-rod in the lower cover. Fig. 4 illustrates the upper and lower sides of the top cylinder cover.

The two fuel valve pockets are formed by copper tubes expanded into holes in the cover and a hole is provided for the relief and indicator connections.

Cylinder Cooling.—One common, closed, fresh-water system is used for both cylinder parts and pistons. For distributing the cooling water evenly about the liner circumferential ribs in the cylinder jacket and multi-connections to the cylinder heads are arranged to obtain even cooling of the heated parts.

Pistons.—The pistons are of cast iron and consist virtually of two single-acting pistons of identical construction. The chief feature of the design—see drawing Fig. 2—is the elimination as far as possible of special water joints and connections and the adoption of special cast nozzles to distribute efficiently the cooling water about the piston. Both pistons may be removed without disturbing the piston-rod and therefore require a minimum of headroom for dismantling.

It will be noticed that the piston top is machined flat, whilst the pistons generally are of a ribless construction. The piston trunk is cast on to the piston body with provision to expand axially.

The pistons are secured to the piston-rod by means of a tapered shoulder and a special round wrought iron nut, the recesses in both piston ends being identical.

Five Ramsbottom cast iron piston rings are fitted to each piston end and are suitably pegged in position.

Piston Cooling.—Cooling water is conveyed to and from the piston and piston-rod *viâ* the crosshead by means of

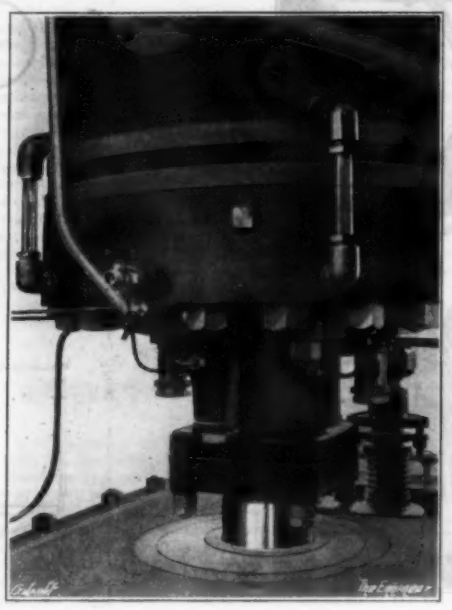


FIG. 7—BOTTOM COVER AND GLAND

two trombone pipes, the plunger tubes of which are attached by a bracket to the crosshead. The outer water chamber is external to the crank case and at the upper post point is mounted in bearings attached to the cylinder casing to give flexibility to the system and allow for any slight movement of the crosshead or mis-alignment of the trombone pipes.

Double glands are provided which are external to the crank case to prevent oil leakage to the cooling water or water leakage into the crank case.

Piston Rod Gland.—The most distinctive feature of a double-acting oil engine is perhaps the piston-rod gland. The gland fitted to the Richardsons-Westgarth engine is shown in Figs. 2 and 7. Its main feature is the long annular water-cooled passage—the full depth of the cover—which the hot gases must traverse before reaching the gland packing rings. This ensures that only cooled gases reach the gland and further will have the effect of damping down the maximum pressures at the gland packing.

The piston rod is of 3 per cent. nickel steel, heat treated to give 50 tons per square inch tensile and ground to size. It is cooled by the passage of water to and from the pistons through the centre of the rod.

Fuel Injection.—A problem which has been always associated with the double-acting oil engine is that of obtaining good combustion in the lower cylinder, the combustion chamber of which is affected by the presence of the piston-rod. In the Richardsons-Westgarth design, instead of arranging the combustion space to suit the fuel valve, the fuel valves are arranged to suit the combustion space and two fuel valves are employed instead of one.

The top and bottom combustion spaces are made almost identical and each consists of a simple annular space with flat ends, the volume being such as to give a compression pressure of about 350 lb. per square inch. The piston rod nut is circular and approximately corresponds with the piston-rod in the bottom cylinder. The piston and cover faces are preferably flat, and not dished; this is the best shape of combustion chamber for use with two solid injection fuel valves, which are arranged to spray practically horizontally round the piston-rod nut in the top cylinder and round the piston-rod in the bottom cylinder. If two fuel valves be used in the manner shown in Fig. 8 the need for special pockets is avoided and the fuel can be efficiently distributed throughout the combustion space.

Fuel Valves.—The engine works on the solid-injection controlled-pump system of fuel injection with spring-loaded automatic fuel valves. There are two identical automatic solid-injection fuel valves for both the top and bottom cylinders, fitted with adjustable spring-loaded needle valves which work in glandless cast iron bodies. The design is such—see Figs. 6 and 7—that the injection pressure of the fuel oil can be regulated by adjusting the spring load on the valve. The fuel jets are in the form of separate detachable nose pieces which can be readily removed on the withdrawal of the valve.

As the type of fuel injection gear described requires

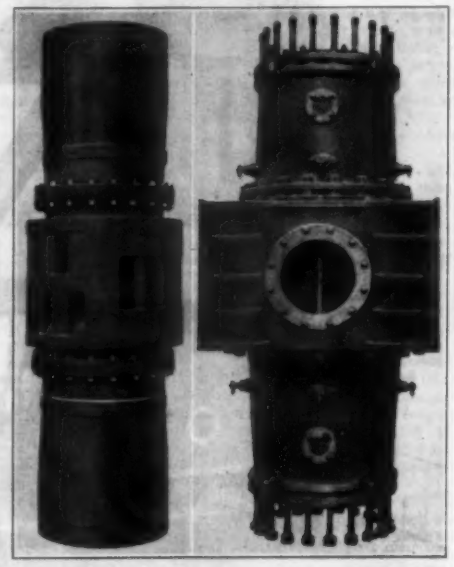


FIG. 9—CYLINDER LINERS AND CASINGS

no direct fuel valve operating gear, the air starting valves in the cylinder heads are conveniently made of the automatic type with operating valves arranged near the fuel pump and driven from an extension of the fuel pump cam shaft. It is therefore possible to eliminate all the usual cam and manœuvring shafts with their attendant bearings, rockers, and driving gear. In other words, all the mechanically operated valve gear about the cylinders is dispensed with and is replaced by the compact unit shown in Fig. 3. It is placed at about floor level at the front of the engine and comprises the fuel pump, governor, starting air operating valves, and running controls. The drive for this unit is obtained from the forward end of the crank shaft.

(To be continued.)

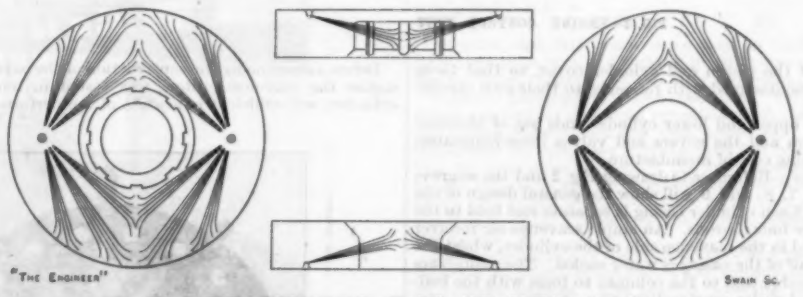


FIG. 8—FUEL DISTRIBUTION IN TOP AND BOTTOM COVERS

A BIG WATER SUPPLY SCHEME.

A bold engineering proposition now being put forward is to furnish a supply of filtered water from Lake Michigan to a series of twenty residential and industrial towns within a radius of 30 miles from Chicago. These places have an aggregate population of about 500,000, and their population increases about 30 per cent. in each decade. Nearly half of the population is in towns not more than 5 miles from Chicago. Most of the towns draw their water supply from deep wells in sandstone formation, but the water is hard, though pure, and the supply is limited, the water level lowering continually. A few places take Lake Michigan water from the Chicago water system, but it requires dosage with chlorine. The plan proposed is to take clean water from the lake by an intake tunnel extending 3 or 5 miles from shore, and filter it at a large treating plant. The filtered water would be pumped through a distribution system with about 50 miles of mains, supplying twenty towns and villages north and west of Chicago. At present the consumption is estimated at 20,000,000 gallons daily, with an increase to 45,000,000 gallons in ten or fifteen years. Elevated storage tanks will provide for peak consumption and a reserve for fire protection. The largest mains will be 5ft. in diameter. The pumping head at the main station will be about 300ft., but auxiliary or booster pumping stations would be installed as the population and demand increase. The initial cost would be about £2,000,000, increasing to £2,250,000 in ten or fifteen years.

Railway Matters.

THE National Union of Railwaymen has now a membership of 398,596, an increase of 7468 over last year and of 91,461 over ten years ago.

THE customary relief train for the 10 a.m. from King's Cross to Scotland will begin to run on Monday next, May 3rd. It will, for the present, run on Mondays and Saturdays only and leave King's Cross at 9.50.

AS there have been several references of late to trouble over short time for shopmen in the London area of the London, Midland and Scottish Railway, we think it desirable to say that permanent way, not locomotive, shops are referred to.

TWO opportunities, in particular, are given to the public to show their appreciation of the good work done by railway servants. One is the annual collection made each New Year's Day for the Railway Benevolent Institution and the other is the annual dinner of the fund. The latter event is, this year, on Thursday next, May 6th. The fund is essentially for the benefit of the staff and their dependants and only secondarily for the salaried members.

ANOTHER 25 miles of the main line between Genoa and Rome has been converted to electric traction and brought into use. The section in question extends between Sestri Levante and Spezia and completes the whole of the 225 miles from the junction with the P.L.M. at Modane. Very shortly Leghorn will be reached and the distance will then be 283 miles. The cable advices sending this information said that that would be "the longest stretch of electrified railway in the world." That cannot be so; the longest stretch is the 440 miles from Harlowton to Avery, on the Chicago, Milwaukee and St. Paul, described in the article by Sir Philip Dawson and Mr. Parker Smith in THE ENGINEER of February 12th last.

IT is fifty years to-morrow (May 1st) since the Settle and Carlisle section of the Midland Railway was opened for passenger traffic, and that company obtained independent access to the Scottish border. The line is 72¼ miles long and cost 3½ millions to build—of which over 3 millions were spent on works—or an average of £49,000 per mile. An interesting point in the history of the line was that the London and North-Western withdrew its refusal to concede terms so that the traffic would continue to travel *viâ* Ingleton and the Lancaster and Carlisle, and offered the joint ownership of the length between Ingleton and Carlisle. The Midland, therefore, sought powers in 1869 to abandon the railway, but the Lancashire and Yorkshire and the North British companies—which wanted an alternative route for their Scottish traffic—successfully opposed the dropping of the scheme.

THE Railway Employment (Prevention of Accidents) Act, 1900, ordered the provision of hand brakes on both sides of wagons. The original Board of Trade rule that followed was somewhat impracticable, and prolonged trials had to be made. The result was that the Railway and Canal Commission, under powers given by the Act, said that the rule was not reasonable. A new rule was then agreed to, and was issued by the Board of Trade on November 7th, 1911. It gave ten years to the owners of under 3000 wagons to do the work, fifteen years to those with 3000 but under 20,000, and twenty years to those with over 20,000. In the year 1920 the first-named class was given another five years, and its period and that of the second-named class would have expired on November 7th next, but by a Ministry of Transport rule, dated March 10th last, a further five years have been given to both classes, and now all must complete the work by November 7th, 1931.

THE Railway Rates Tribunal has now begun the consideration of the standard charges which are to operate on the four grouped systems from the "appointed day." In this relation we would like to observe that Mr. Macmillan, in opening for the railway companies, corroborated a statement made in our leading article of March 26th on "The Railway Year." He said: "Whereas hitherto the actual charges had to some extent been left to the discretion of the railway companies . . . in future the standard charges which the Tribunal were about to fix were to be not maximum charges, but actual charges." Mr. Macmillan also said that the railway companies still hoped that the appointed day would be January 1st, 1927. If the present inquiry were concluded by the end of May the companies could, with the expenditure of a great amount of work, have the new rates on their books by September 30th next, thus giving an interval of three months before the new charges came into operation. Earlier in his remarks counsel said, on the subject of fares that to-day were below the standard, that they would come up for reconsideration as to whether they should be continued as exceptional fares. In many cases such fares would be continued. It was no part of the policy of the railway companies to make any increase in passenger fares.

AT the Institution of Railway Signal Engineers last week a paper, entitled "A Comparative Survey of American and British Signalling," by Mr. Joshua Parsons, was read. Mr. Parsons, who gained his signalling experience on the Midland Railway and is now the telegraph and signal superintendent of the Central Argentine, spent his holiday last year in England and visited the United States on his way back to Buenos Aires. Whilst the paper was of great interest and provoked a very gratifying discussion, no pronouncement was made as to the variations in the practice in the two countries. The following remark as to automatic train control should, however, be put upon record:—"Although unquestionably much can be said for the attempt to eliminate accidents resulting from 'man failure,' yet even after the most elaborate precautions have been taken it is almost impossible to make any apparatus absolutely fool-proof and failure may still occur, though, no doubt, the possibilities are greatly reduced. If a railway is to be operated as a business concern it cannot be expected to provide more than what can justly be considered as a reasonable degree of protection, and it would appear to be very hard to justify economically the very heavy expense involved by the introduction of any form of automatic train control, except, of course, train stops on electric suburban railways such as the London Underground."

Notes and Memoranda.

ONE of the single-engined D.H. 34 passenger aeroplanes of Imperial Airways, which has been superseded by the new multi-engined model, flew 300,000 miles during its active life.

A FINE wooden stove pipe has been built by the California Oregon Power Company to connect two concrete-lined tunnels and convey 3000 sec. feet of water under a head of 60ft. It is 1318ft. long by 16ft. in diameter, and is built of creosoted staves 4in. thick by 5½in. wide. The reinforcement is ¾in. steel bands spaced at distances of from 3·62in. to 3·71in. apart.

ENDEAVOURS have been made, according to *Canada*, to ship coal from Alberta and Saskatchewan by rail as far east as Toronto, a distance approaching 2000 miles, but by the lowest freight rate obtainable this has not proved a successful commercial undertaking. It is believed, however, that by a process of carbonisation, by which two tons of raw coal are concentrated into one ton of briquettes, the problem of transporting carbonised fuel from Western Canada to Eastern Canada can be made profitable.

A HOBART message says that a discovery has been made of a new alloy of chromium and iron which promises to be of great value to the Tasmanian mining industry. It is stated that the use of a lower percentage of chromium than is employed in the production of stainless cutlery, converts the steel into a new metal of considerable value, though its properties are not revealed in the message. Chromium ores, it may be mentioned, are found in several parts of Tasmania, always being associated with osmiridium.

AN apparatus for dispersing fog is being developed at the Philadelphia Naval Aircraft Factory. A simple charging screen, a transformer with rectifying device, an aeroplane propeller and a meter, all mounted on a truck, will, it has been found, electrify 700,000 cubic feet of air a minute and cut a path 2000ft. wide and 1000ft. high through a fog. The experiments were undertaken to reduce one of the risks of flying, but the possibilities include the lessening of traffic dangers in large cities on foggy days and the reduction of peril and delays to shipping in crowded harbours.

THE purpose of an investigation being conducted by the U.S. Bureau of Mines has been to permit a calculation of the velocity of the ascending gas at any position inside a blast-furnace. None of the components of the burden in the furnace is being sized, and the average size of each differs one from another. With the bell-and-hopper way of filling, there is, it has been found, segregation of coarse and fine stock radially at the stock line. Lower in the furnace this segregation is accentuated by the irregular descent of stock in the furnace. The stock descent is irregular across any horizontal section of the furnace, owing to localised combustion at the nose of the tuyeres.

LARGE amounts of sulphur dioxide may be generated, according to Messrs. Gardener, Jones and Sullivan, of the American Bureau of Mines, in blasting in heavy sulphides, particularly in dry working places where dust has settled on the walls. There also appears to be danger from sulphide dust explosions when blasting in such places. The deadly gas, hydrogen sulphide, is also likely to be produced in blasting in heavy sulphides. Water in drill holes appears to increase the amount of hydrogen sulphide generated when blasting in such places. Ventilation currents should be arranged in such a manner that there is no possibility of men getting caught in gases from blasting in heavy sulphides.

A PROCESS which appears to have commercial possibilities is, according to the *Iron and Coal Trades Review*, being developed for the utilisation of Canadian ilmenite ores. By this process electrolytic iron, in the form of tubes and plates, is produced from the iron content in the ores, and a white pigment from the titanium content. The commercial uses of pure electrolytic iron are now many. There is already a considerable market for certain purposes, which should increase with production. Titanium pigments are claimed to be superior for many purposes to lead and zinc pigments. The success of the process, obviously, depends, to a large extent, on a cheap supply of raw materials and power.

SOME experiments have recently been carried out, according to *The Times*, on the relative merits of wooden and metal propellers for aircraft. It is said that when starting from a height of 1000ft. the machine with a wooden air screw took 1 min. 1 sec. to reach 1500ft., whereas with the metal air screw and the same engine revolutions the time was only 54 sec. At 3000ft. the times were 3 min. 52 sec. for the wooden air screw, and 3 min. 29 sec. for the metal. At 5000ft. the figures were 8 min. 3 sec. and 6 min. 37 sec.; at 7500ft., 15 min. 6 sec. and 11 min. 39 sec.; and at 10,000ft., 24 min. 16 sec. and 19 min. 12 sec. From about 5000ft. the engine with the metal air screw was running at between 10 to 20 revolutions per minute more than when fitted with the wooden type. The total loaded weight of the machine was 3410 lb. With the wooden air screw the absolute ceiling was 16,100ft., and with the metal 18,300ft.

IN the course of a paper read before the American Electrochemical Society, Mr. P. S. Brallier said that zinc chloride, either in anhydrous form or in solution, can be prepared by the action of chlorine on metallic zinc. If the anhydrous chloride is to be made, dry chlorine is brought into contact with molten zinc at 500 deg. Cent. or above. The physical properties of zinc and zinc chloride make possible the operation of the two main classes of chlorinating furnace, differing from each other in the method of heat removal from the reactor. The simplest chlorinator would consist of a steel or cast iron box or pot, suitably lined with a refractory clay. Molten zinc, heated somewhat above its melting point, would be introduced, a chlorine inlet submerged in the molten metal, and the chlorine turned on. The fluid zinc chloride as formed would float on top of the metal, and could be tapped off into containers, once it had built up to a proper level in the reactor. Additional zinc could be added from time to time in solid form, the reaction heat serving to melt it.

Miscellanea.

A DISCOVERY of tin is reported in association with an occurrence of greisen 30ft. thick on Babel Island, near Flinders Island, Tasmania.

A COLD storage plant and ice factory is to be put up at Halifax, Nova Scotia, at a cost of 2,000,000 dollars, and is to be in operation in May, 1927.

IT is reported that an important discovery of gold-bearing ore has been made near Yilgarn, West Australia. The ore is said to average 30 dwt. of gold per ton.

THE hydro-electric power plant at Mulungushi, of the Rhodesian Broken Hill Company, is to be extended by the addition of two 5000-kilowatt Pelton wheel units.

THE works which are nearing completion in Quebec harbour will provide an additional quay approximately half a mile long, 500ft. out from the present shore line.

TWO new wireless installations are to be set up in Venezuela, one at Caracas, capable of communicating with New York, and the other at Maracaibo, for messages to Caracas, the capital of the republic.

IT is said that the coal measures of the Klip River Valley, South Africa, include a seam of 211ft. 6in.—probably the thickest ever discovered—of which 70ft. is of good marketable quality, while the remainder is usable.

THE new dry dock at Skinner's Cove, Victoria, British Columbia, which will ultimately cost some 6,000,000 dollars, is to be opened about the end of July. The second gate, made by Yarrows, will be launched very shortly.

IMPORTANT discoveries of gold seams have, says the *Latin-American World*, been made in the region of Cicapra, in the State of Bolivar. This neighbourhood is renowned for the number of gold mines discovered there in bygone days.

IRON and steel works are to be erected on the shore of the Black Sea and the environs of Alexandretta. The output of the iron mines at Seyudusi is to be increased considerably, and search for coal is to be made near the Black Sea.

IN order to increase the supply of calcium carbide in the Soviet Union, which at present is only equal to less than half the requirements, it has been decided that the Makeyevski works belonging to the Yugostal are to be re-opened to-morrow.

THE Exhibition in connection with the Riga Fair is to be held this year from June 13th to June 27th. At the end of the Fair an international competition of the machinery exhibited is to take place. Further particulars may be obtained from the Ixstade Company, Gr. Sandstrasse 27, Riga, Latvia.

SULPHUR production in Java has begun at the Kawah Poetih (volcano), south of Bandoeng. The company is, says the *Chemical Trades Journal*, now apparently in a position to make deliveries, and in view of the yearly consumption, which amounts to from 6000 to 10,000 tons, it may be assumed that the product will find a considerable market locally. The principal consumer is the sugar industry.

THE Big Valley Hydraulic Tin Mining Company intends, according to *Chemical Engineering* of Melbourne, to develop the water power resources of Mount Cameron on the east cost of Tasmania. The mountain is about 2000ft. high, and through it run two valleys at different altitudes with separate outlets. The water will be turned from the upper valley to Big Valley (the lower), and a dam will conserve and regulate the flow of water from the mountain. A head-race of less than half a mile in length will then bring the water to a point on the mountain side 334ft. above the Ringarooma River.

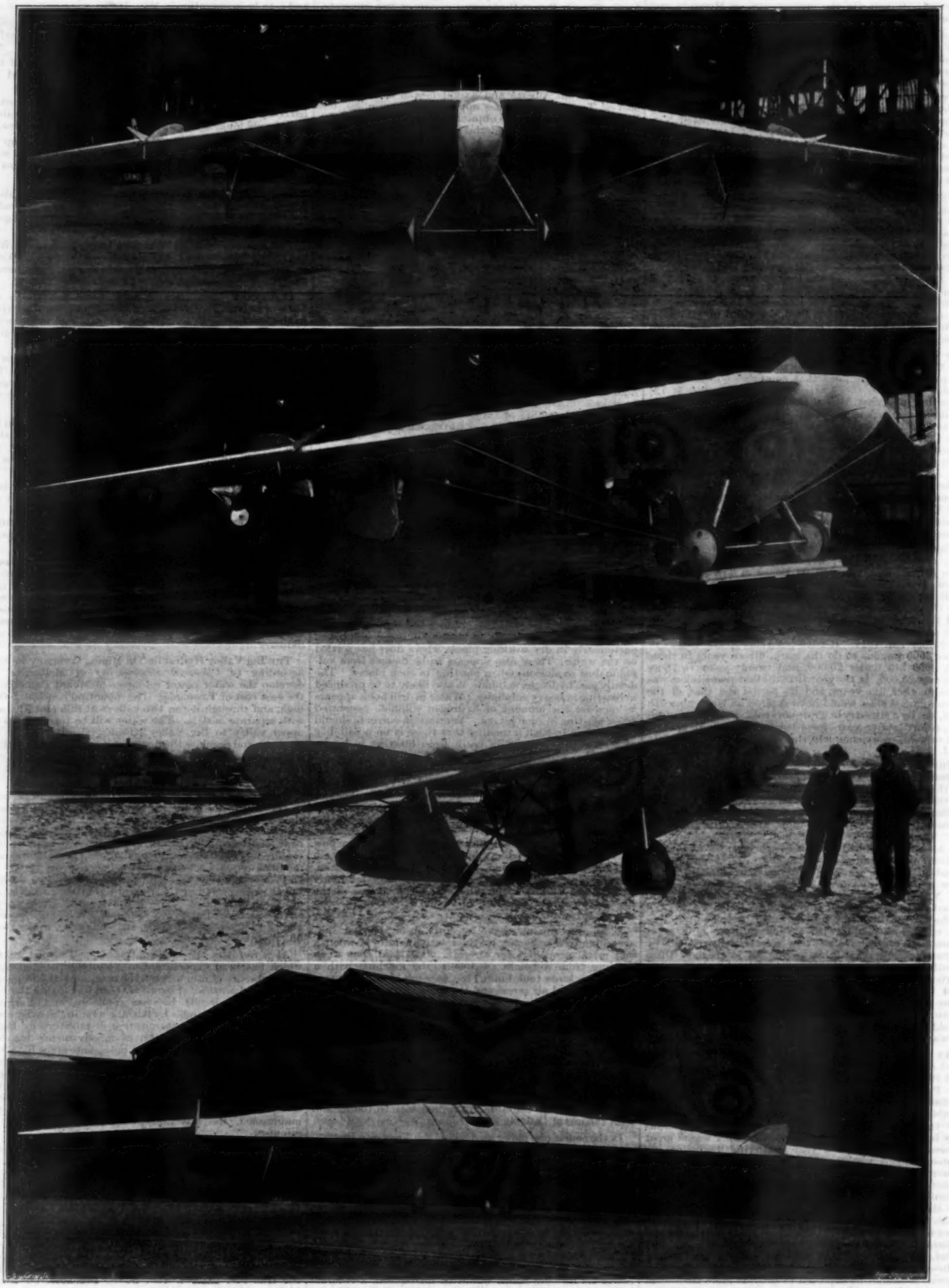
A CABLE is being laid to link up the collieries included in the Doncaster Collieries' Association. By this means these collieries will be able to pool their surplus electricity, which is mainly generated at each colliery from waste heat, and to supply the common main or draw from it as required. This circuit of the Markham collieries is a modification of a scheme proposed some years ago by Mr. C. P. Markham for South Yorkshire collieries as a whole, but it was rejected at that time owing to engineering and financial difficulties. The laying of the cable is well advanced, according to the *Iron and Coal Trades Review*, and the collieries will be efficiently linked up in the course of a month or two.

AS a result of the long-continued spell of dry weather which has been experienced in Victoria, with the consequent absence of rain to wash the insulators, it has, according to the *Industrial Australian*, been found that the main transmission circuits between Yallourn and Yarraville have given some trouble by flashing over in the early morning hours, when the precipitation of moisture by fogs is greatest. A certain amount of inconvenience has been caused by these flashovers, but immediate steps have been taken to remedy the trouble and prevent a recurrence of such a very rare incident due solely to the long absence of rain and the inevitably large amount of dirt in the atmosphere. While the incident has occasioned some trouble to the responsible engineers, the services have been well maintained, the interruptions only lasting for a few minutes.

THE Brisbane City Council proposes to erect a power-house to supply South Brisbane with electric current, and has, according to the *Commonwealth Engineer*, invited tenders for two turbo-alternators of 6000 to 7500 kilowatts. A committee of the Council has reported:—In view of the fact that the City Electric Light Company is not prepared to quote a figure at which it is prepared to sell its undertaking, but definitely desires acquisition by resumption, this Committee is of opinion that it would be more economical to purchase and erect power plant for the purpose of taking over the first area for which the franchise expires, viz., South Brisbane, on August 10th next, with a margin for power requirements for the tramways. The Committee, therefore, advises that immediate steps be taken for the purchase of the necessary plant and acquisition of land for the power-house. This initial plant could be added to from time to time to meet the requirements of the expiring franchises.

THE "PTERODACTYL" TAILLESS AEROPLANE

(*For description see page 501*)



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Half-yearly (including index number) .. £1 12s. 6d.
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The Metallurgist

THE APRIL NUMBER OF THE MONTHLY METALLURGICAL SUPPLEMENT TO "THE ENGINEER" ACCOMPANIES THIS ISSUE.

DEATH.

On the 17th inst., Mr. R. H. Neal, founder and managing director of R. H. Neal and Co., Ltd., of Plant House, Longfield-avenue, Ealing, London, W. 5.

THE ENGINEER.

APRIL 30, 1926.

Naval Engineers.

To-day we print an article on the Engineering Branch of the Royal Navy, to which we desire to direct the special attention of our readers. At no time has it been more important that, not only engineers themselves but the general public, should take awakened interest in everything connected with the Navy. Owing to the dictates of economy, which we are all agreed is essential, and to the limitations which were laid down at Washington, the British Navy is far smaller than it was, but with decreasing size it is imperative that increased efficiency should be effected. Unfortunately, as has happened on previous occasions after great wars, the interest in our first line of defence is not as great as it was. It is to be feared that the general public is less well informed than it used to be upon the progress of fighting ships and, we may add, about that great branch of the service, the Royal Naval Engineers, on whom rests the chief responsibility for their efficiency and readiness for service. This lack of interest is, we are convinced, in no small measure accounted for by the policy of excessive secrecy which has gradually grown up in the Navy since the Dreadnought was built behind a barricade. Of that secrecy and its effect we spoke strongly in a leading article in our issue of April 16th, and it is only necessary for us to say once more that it appears to us to be undermining not alone the intelligent interest the general public took in ships of war, but, what is more serious, even the interest of naval architects and engineers. There can, we fear, be no question whatever that the meetings of the Institution of Naval Architects have lost a good deal of their appeal to the general reader by the absence of those enlivening and instructive debates on naval construction and naval engineering which were a common feature of the spring meetings only a few years ago.

But it is to that indispensable branch of every modern Navy which has so recently been subjected to an official slight, that we desire to direct the attention of our readers to-day. If they will but turn to the article to which we have already referred, they will find there a brief history of the origin and progress of engineering in the Navy. We feel confident that they will be impressed by the ever-increasing part that engineers have played in the development and employment of ships of war. They will be struck, too, by the fact that the education and training of engineers for the Royal Navy have steadily advanced as the years have passed by. They will see, particularly in the latter part of the article, that amongst engineers of the Royal Navy there have been men of fine education and wide reading—qualities which above all should, and indeed do, in these days remove the last trace of social stigma. It may be freely admitted—even with some measure of pride—that in the early days of steam engineering, and for many years afterwards, the engineering branch was drawn from a section of society which lived by manual effort, and which did not enjoy those advantages of a public school and university education which gave the executive branch that social standing on which it claims superiority. Since the time of Selborne, Fisher, and let us say particularly of our brother engineer, D. B. Morison, that social distinction has gone and the Engineer-Officer takes his place at table beside his brother officers of the deck. Yet some of the old feelings and some of the old anomalies remain. They were gradually disappearing under the influence of wiser counsels, but were suddenly brought into prominence again by the notorious Fleet Order of November last. That Fleet Order, as we have said before, was not only a slight to every Engineer Officer and man of the Royal Navy but to every engineer in the world, for, whatever may be said in extenuation of its meaning, there can be no doubt whatever that its effect must be to build up a barrier between executive and engineer officers which we had hoped had been for ever removed. In the House of Commons, on April 21st, Mr. Bridgeman asked what power the Engineers had lost which they enjoyed before the Fleet Order of November last was issued. The Speaker intervening, no reply could be made at the time, but in the *Times* of Wednesday last categorical answers are given by Engineer-Rear-Admiral Charles C. Sheen (Ret.). Under ten headings the writer shows what Engineers have forfeited with the loss of Executive rank. The folly of the Order is made clear when it is observed that amongst the losses are, command of technical establishments and schools ashore, eligibility for shore appointments such as Superintendents of Dockyards, and the charge of all technical work with sole responsibility to the Commanding Officer of the vessel.

For one cause and another the efforts which are being made to bring about the abrogation of that Fleet Order have been delayed, but it must not be thought that it has been forgotten, and that the matter will be allowed to rest in its present outrageous position. The Institutions which waited on Mr. Bridgeman may be trusted to press on with their demands, but unless they have the support of the public, and particularly of all engineers from the highest to the lowest, they cannot count confidently upon success. We are glad to say that the public has been deeply moved by what it counts justly as a gross unfairness to a magnificent branch of the service, but it must not be ceasing in its expressions of sympathy with engineers, and engineers themselves must spare no pains and relinquish nothing of their determination to see the order rescinded. It is because we believe that the article which we print to-day will do something to encourage interest in the engineering branch of the Navy that we invite the attention of our readers to it.

Improvement in Boiler Design.

Power station engineers are urging boilermakers in two different directions. On the one hand, they are asking for larger and larger boilers, and, on the other, they are calling for higher and higher pressures. These two requirements have no connection with each other. Larger boilers are needed to keep pace with the ever-increasing size of generating units, so as to maintain some kind of proportion between the steam-raising and the steam-using items of the plant. The tendency indeed is to reduce the ratio of boilers to turbines, and in spite of the greater size of the latter most engineers would agree that three boilers per main turbine is a more satisfactory proportion than the five or six boilers per turbine which was the custom not

so very long ago. This tendency to diminish the boiler ratio accentuates the demand for boilers of greater individual capacity, and the boilermaker is faced with problems in respect of furnace construction, firing methods, draught control, ash evacuation and general operation which grow in intensity as steaming capacity is increased. At the same time he is pressed by another set of clients to offer them boilers for working pressures of anything up to 1200 lb. or 1500 lb. per square inch. Fortunately for him, these enterprising spirits do not as yet generally envisage units of very great steaming capacity. But with boilers of 26,000 lb. normal capacity per hour already successfully working at 800 lb. per square inch, boilers of approximately the same size now being put into service at a pressure of 1200 lb. per square inch, and a boiler of 156,000 lb. capacity at 620 lb. pressure being at present under construction, the trend of events is obvious.

The reasons which led to the demand for boilers of very large capacity for pressures which are now regarded as moderate are bound to act to an almost equal extent in the case of boilers for very high pressures. Engineers will not be satisfied until the efficiency due to high-pressure steam can be married to the operating advantages secured by having boilers of a suitable size for modern turbine plant, and it is the boilermaker who will have to introduce to the world the offspring of the union. What form the boiler of the future power station will take is, as yet, by no means evident. The last few years have witnessed an extraordinary amount of development work in connection with boiler plant, and at the present time boilermakers in different parts of the world are actively engaged in seeking new or improved methods of steam generation. It is never safe to prophesy, but we are justified in believing that working pressures are unlikely to exceed 1500 lb. per square inch for a long time to come. The benefit of increased pressure is, like most other advantages, subject to the "law of diminishing returns," and there seems to be a general consensus of opinion that the returns in efficiency secured by exceeding this pressure would be negligible as compared with the expense involved. Many engineers would indeed place the practical limit below 1500 lb., but the work now being done on the development of boilers up to this pressure is sufficient evidence of a belief that it may be attained with advantage. The Benson boiler, indeed, generates steam at 3000 lb. pressure, but steam at this tension having a saturated temperature of 689 deg. Fah. is already too hot to admit of much superheating. Adiabatic expansion of such steam would instantly result in about half of it being turned into water. For this and other reasons the steam is reduced to 1500 lb. pressure by throttling, and then superheated, the final result being the same as if it had been generated at 1500 lb. pressure in the first instance. The Benson boiler, however, is of particular interest in that, requiring no disengaging surface for the steam, it needs no drum of any kind. At the pressure and temperature of working, water and steam are of equal density and are in fact the same thing, so that there is no demarcation of any kind between the two. The avoidance of the necessity for a drum eliminates at once the most expensive and highly stressed element of a high-pressure boiler and, provided that the feed supply can be regulated in sufficiently close accordance with the output, the boiler would seem to have possibilities for very high-pressure work. At any rate it is a bold attempt to advance on existing practice and its performance is now being studied in Germany on a commercial scale.

If steam is to be generated at any pressure below its critical pressure of 3000 lb. per square inch some kind of drum for the disengagement of the steam will always be necessary, that is if we exclude boilers of the pure "flash" type, such as those experimented with in small sizes for some of the earlier road vehicles. These may be left out of consideration from a practical point of view, so that in general it is the problem of the drum design which besets the makers of boilers for very high pressures. Drums with any sort of pressed deformations to accommodate the tubes would seem to be inadvisable for pressures above about 500 lb. per square inch, a true cylindrical surface being required in the case of higher pressures. Even supposing a true cylindrical form, however, the possibility of constructing such drums by ordinary boilermaking methods soon reaches its practical limit. Riveted drums of 42in. diameter are actually in daily use up to a pressure of 800 lb. per square inch, but, on the other hand, drums made from a solid forging have been adopted for pressures as low as 620 lb. per square inch, and it is almost certain that when forge masters lay themselves out to supply the needs of boilermakers the riveted drum will tend to disappear for all pressures above 600 lb. or 650 lb. per square inch. It is significant that during three and a-half years Messrs. Krupp have supplied 170 seamless forged drums for boilers alone, besides an approximately equal number for chemical and other processes which demand very high pressures. Mr. Tresilian stated in a discussion before the Institution of Civil Engineers about a year ago that one British firm, at least, was prepared to produce solid forged drums up to 35ft. long and 4in. thick for boilers, but in view of the progress already made on the Continent there would seem to be scope for more activity in this direction amongst our forge masters. In America a solid forged drum, 34ft. long, 48in. inside diameter, and 4⅛in. thick, has been made for the 1200 lb. boiler installed at Boston, Mass. It is not, however, only with regard to the drums that the designers of extra high-pressure boilers are seeking original methods. In the Swedish "Atmos" boiler, working at 1500 lb. per square inch, steam is generated in rotating tubes, the idea being apparently to facilitate the removal of the bubbles of steam from the tube walls by the centrifugal force of the rotating water and by the same force to press the water against the walls of the tubes. One would imagine that the higher the pressure the less necessity was there for such an expedient, for the bubbles of high-pressure steam would naturally be smaller than bubbles of low-pressure steam, and the latter seem to find no difficulty in getting away in any properly designed boiler. Many inventors seem concerned to find some method of preventing the access of heat to any portion of the drum of high-pressure boilers. It would, of course, be perfectly easy to remove the drum of an ordinary water-tube boiler entirely from contact with flue gases, or to protect it from them with insulating material, if there seemed any sound reason for such precautions. But such simple methods are perhaps too simple. Hence indirect means of raising steam have been devised. Professor Löffler advocates evaporating the water in the drum by bringing it into direct contact with superheated steam. The saturated steam so produced is taken to a superheater and when raised to a sufficiently high temperature is pumped back into the drum underneath the water level. Leaving aside the difficulties of starting such a plant in the first place, it would seem a retrograde step to utilise the furnace heat in a superheater, where the rate of transmission is low, rather than in the water tubes of a boiler, where a much better heat transmission is obtainable. Furthermore, practical engineers would hardly like to trust the safety of a plant to the continuous operation of a steam pump working at a very high pressure.

A somewhat similar, but equally indirect, method of raising high-pressure steam is being experimented with in Germany at the present time on a practical scale. In this scheme there is, in effect, a double boiler. The heat of the furnace is used to raise steam in what may be called a primary boiler which works on a closed circuit. This primary steam passes through a heating coil submerged in the drum of the secondary or main boiler, then through a feed heater and then back to the primary boiler. It is clear that with such an arrangement the primary steam must be at a higher pressure or temperature than the secondary useful steam, in order to get heat transmission through the coil. Moreover, even supposing that the heat transmission rate through the coil could be made equal to the 7000 or 8000 B.Th.U. per square foot per hour which is attained in an ordinary boiler, it is evident that to get the output of an ordinary boiler we should have to find room inside the drum for a coil equal to the whole boiler heating surface. There would apparently not be much room for water in the drum under these conditions. It is difficult to be sanguine as to the commercial success of such indirect methods of steam raising, even if they are technically practicable. That there are people willing to bear the expense of building actual boilers on these lines in the hope that they may effect improvements in the practice of steam generation is, however, a fact. It is, moreover, significant of the "liveliness" which exists in boiler circles abroad, where efforts to make progress both in the generation and utilisation of high-pressure steam are decidedly more active than in England. It is to be hoped, for the sake of British engineering prestige and for the trade that prestige brings, that our own engineers will make progress on their own account and not lose the lead in steam engineering which they inherited from progressive engineers in the past.

Adhesives.

The second report of the Adhesives Research Committee, which has just been issued by H.M. Stationery Office, does not carry us much further in the attempt to discover why some adhesives are more satisfactory for given purposes than are others, and to some extent the report leaves us even more confused than ever. In this connection, it is significant that the manufacturers of bone glue have ceased to support the Committee financially, although makers of fish glue have come forward with offers of support, which have enabled the work to be carried on on a fairly large scale. The fish glue industry, by the way, is by comparison fairly young, and has not been developed to the same extent as the bone and hide glue trade. The report, nevertheless, offers a large amount of material for consideration, and leads one to the impression that the researches of the Committee might have been carried out on rather different lines.

Apart from the bookbinding trade, glue is probably used more extensively for joining wood than for any other purpose; yet it is asserted in the appendices to the report, both by Professor McBain and by the Royal Aircraft Establishment, that wooden test pieces are unsatisfactory for determining the strength of glued joints. This contention is based on the fact that such joints have been proved to fail under stresses considerably below the tensile strength of the glue itself when tested as a thin film. The function of the glue is to make the connection, not to provide strength in itself, and it is agreed by the Professor that the joint relies for its strength on the embedding of the glue in the surface pores of the wood, so that it would appear that the penetrative ability of the adhesive should be equally as important as its innate strength. But here one is confronted with the anomaly that when compound test pieces were made up of two metal specimens with a piece of walnut wood sandwiched between them, it was often found that the junction with the metal was stronger than that with the wood. And this in spite of the fact that the metal faces were very carefully prepared so as to be smooth, which leads one to assume that the glue would have little penetrative opportunity. On the other hand, it was found that two roughly machined metal faces could not be glued together nearly so securely as could two of the same metal if they were highly finished. Two more contradictory parts of the report are those in one of which Professor McBain says that tests carried out with optically plane surfaces of mild steel and nickel, cemented together by means of shellac, "prove beyond doubt that surface roughness plays but a negligible part in determining the strength of a 'specific' joint." In the other, he records how, in one set of experiments, more concordant and higher results were obtained when the metal surface was first painted over with the adhesive, which was allowed to dry, and then another cementing layer was applied to make the actual joint. It would appear that if there is any intermolecular penetration between the adhesive and the object, which might explain away the difference in strength, such penetration would have a better chance of happening in the case of the double coating system, and it surely must have some relation to roughness, even if that roughness is of a microscopic character.

It is obvious from all these contradictory facts that the testing of glued joints in a comparative manner is a subject of great difficulty, and it must be especially so in the case of wooden joints, as they are almost invariably in shear. From the way the shear test pieces are made up, it is inevitable that the joint will fail progressively, by the wood stretching slightly and concentrating the load on the outside of the joint. This trouble might be overcome by securing thin veneers of wood to rigid supports, by means of a glue stronger than that under test; but the most consistent results would probably be obtained by testing the joints in pure tension and examining the subsequent fractures microscopically.

In the course of a paper read before the British Acetylene and Welding Association, Mr. C. R. Houseman said that experiments carried out with oxygen cutting blow-pipes, on 2in. steel plates, in which the purity of the oxygen varied from 98·5 to 99 per cent., showed that this small variation in contamination had a very serious effect on the efficiency of the apparatus.

The Tailless Aeroplane.

WE were unfortunately unable to obtain photographs of Captain G. T. R. Hill's tailless aeroplane in time to use them for the purpose of illustrating the description of the machine which we published in last week's issue. The photographs were received subsequently to our going to press, and are reproduced in this issue on page 498. They are Royal Air Force official photographs, and the Crown copyright in connection with them is reserved.

The machine is structurally tailless and undoubtedly merits the title which its inventor has bestowed upon it. We feel, however, that, aerodynamically considered, it is less entitled to the description. The full-on side view reveals the fact that the projected length of the machine is about the same as the overall length of a conventional aeroplane of similar power. As a result of the very pronounced backward sweep of the wings—the leading edge slopes rearward at an angle of 31 deg. and the trailing edge at 14 deg.—the wing tips are brought approximately into line with the position which the tail organs of a corresponding normal machine would occupy. We may, therefore, possibly with advantage in studying the theory of the machine, regard it not as tailless, but as possessing a split tail. The usual tail fin and rudder have been duplicated and placed at or near the ends of the fixed portions of the wings, and have suffered more of a sideways than a forward translation. The usual elevators, the remaining organs of the conventional tail, have suffered a similar translation to the wing tips. In these positions they naturally coincide more or less completely with the conventional ailerons. The movable ends of the wings are referred to by the inventor neither as elevators nor ailerons, but as controllers. They act as elevators when operated simultaneously, and as ailerons when moved differentially. This brief analysis of the design is in no way intended to belittle its ingenuity or its praiseworthily daring departure from familiar ideas. We advance it simply as a simple means of understanding the machine in terms of familiar ideas.

Apart from questions of stability and control, the tailless or split tail design possesses several interesting and important features. One of the chief is the fact that it permits the designer to revert to the pusher type of air screw in place of the at present almost universal tractor screw. With the engine and propeller at the rear, the view forward and downward is practically unobstructed, and for military purposes the advantage is gained of being able to dispense with intricate timing gear for the machine gun. There would appear to be no reason why a tractor screw should not continue to be used, so that those who favour a forward position for the engine as a means of lessening the pilot's risk in the event of a nose crash may continue to have their wishes fulfilled.

Another and perhaps even more important advantage of the tailless design is to be found in the fact that it greatly lessens both the weight and the air resistance of the body of the machine. In a conventional aeroplane the fuselage structure from the trailing edge of the main planes to the tail has to be designed with a view to the very considerable bending moments thrown upon it by the action of the tail organs during manœuvring. To what extent the saving in weight thus achieved will permit ultimately a saving in the gross weight of the machine we are unable at present to say. For the time being it would appear that there is no economy in the gross weight, and that much, if not all the weight saved in the fuselage, is lost again in the extra weight which would seem to be required in the wings to enable them to transmit the forces from the control organs attached to them over and above the normal aileron stresses. One reason for believing this result to be true is based on a comparison of Captain Hill's machine with a normal light aeroplane—the Beardmore "Wee Bee"—fitted with the same design of engine—a Bristol "Cherub"—and capable of flying at the same speed—70 miles an hour. The machines, we find, weigh within a few pounds of each other, the weight of the Beardmore machine when empty being 462 lb. and that of the tailless machine in like condition 458 lb. It should be noted, however, that the weight saved in the body of the tailless machine is transferred largely, or so we take it, to the wings; that is to say, from a dead part of the machine to a part contributing lift. Economically, therefore, the distribution of weight in the tailless machine would seem to be more satisfactory than it is in the conventional type of aeroplane. It should also be noted that only one tailless machine driven by an engine has so far been produced, and that, with further experience, the characteristics of the design will doubtlessly be improved. The machine which has been constructed is of the light aeroplane class. How the design will fare when it is applied to a full-sized, full-powered machine, is at present an interesting subject for speculation.

A small advantage of the tailless design, but one that is worthy of mention, is to be found in the fact that it results in the removal of the tail fins outside the slip-stream of the propeller. In an ordinary aeroplane the slip-stream strikes the tail fin before all its rotary motion has disappeared. As a result, there is produced a definite tendency for the machine to turn to one side, which tendency has to be corrected, for straight flight, by a constant small rudder angle. In the tailless machine this tendency should be entirely absent.

From the constructional point of view, the feature of the design open to most criticism is, as Captain Hill himself apparently recognises, the form of the wings. It is a little difficult to appreciate this form from our illustrations. We may therefore repeat that the wings have no dihedral angle, that the forward edges are swept back at more than twice the angle of the trailing edges—31 deg. and 14 deg. respectively—that the trailing edges are reflexed upwards by a small amount throughout their lengths, and that the angle of incidence is washed out by 3 deg. from the root of each wing to the point of attachment of the struts and by a further 3 deg. to the tip. The sweep back of the wings is an aerodynamic feature adopted for the purpose of securing a constant centre of pressure at all angles of incidence. The fact that both edges are not swept back equally, so as to give a parallel wing, but are arranged to present a tapered plan, is explained partly by aerodynamical considerations, but mainly by the designer's desire to reduce the chord of the controllers which continue the outline of the fixed wings. It will be readily appreciated that from the point of view of production, tapered wings are objectionable on the ground that no two ribs are alike and cannot therefore be assembled from standard components by the aid of standard jigs.

The machine, as we indicated last week, has remarkable flying properties. The controls remain effective up to angles of incidence as large as 45 deg. There is no marked division between stalled and normal flight. From the stalled condition, as a result of the effectiveness of the controls, the pilot can recover normal flight by gradually easing the control stick forward and without executing the usual dive to regain speed. An accidental stall near the ground should therefore lose much of its risks. Landing, Captain Hill states, is extremely easy, so much so that it seems almost impossible to alight badly. With the brake applied to the rear wheel the run after landing is very short.

There are, however, one or two characteristics of the machine which are not altogether in its favour, although experience may enable them to be surmounted. When taxying on rough ground, it appears to the pilot to be pitching badly and to be in imminent danger of overturning. This effect is produced by the shortness of the wheel base—5ft.—and the absence of a tail skid, together with the fact that the pilot is seated some considerable distance in front of the wheels. It would appear that the pitching movement is more alarming to the pilot than to the spectators, that there is no real danger in it, and that after a few flights the pilot gets used to it.

When the machine is taking off a period is encountered during which the directional control is weak. Since the effect produced in a normal machine by the slip-stream passing over the elevators is absent in the tailless machine, it runs along the ground on all three wheels, until shortly before it rises. For a short time the steering power of the back wheel falls off as the weight on it decreases, while simultaneously the air rudder power is still insufficient to make up the loss. During this period movements of the rudder bar have little effect, but only on one occasion, Captain Hill states, has this momentary absence of directional control given rise so far to difficulty in taking off.

In the air the least satisfactory feature of the control system is the excessive amount of inertia that exists in it. This inertia, according to the designer, is equivalent to a weight of about 75 lb. on the top of the control stick, and tends to mask the aerodynamic "feel" of the controls when the machine is being manœuvred. It renders the control tricky, different from what the pilot is accustomed to, and unpleasant in "bumps." This inertia effect is stated to be peculiar to the actual machine constructed. By lowering the gear ratio between the stick and the controllers, by reducing the controller area and by reducing the inertia of the balance weights attached to the controllers, it is anticipated that the inertia effect will be reduced to a small fraction of its present amount in a machine of a production type.

We give below a summary of the principal dimensions and weights of the "Pterodactyl," as recorded by Captain Hill in his paper read before the Royal Aeronautical Society on April 22nd:—

Area of main plane	223 sq. ft.
Area of controllers	55 sq. ft.
Area of rudders	13 sq. ft.
Wing span, overall	45ft.
Wing span, fixed part only	30ft.
Weight empty	458 lb.
Petrol and oil	30 lb.
Pilot	170 lb.
Passenger	170 lb.
Total weight as a two-seater	828 lb.
Loading, lb. per sq. ft., single-seater	2·0
Loading, lb. per sq. ft., two-seater	3·7
Loading, lb. per H.P., single-seater	20
Loading, lb. per H.P., two-seater	25

The machine as constructed is designed to carry the pilot and a passenger. Captain Hill's next intention is to try a rearrangement of the design which, he believes, will result in a considerable reduction of head resistance. He anticipates applying the same principles to a large-size biplane machine, and foresees being in a position to effect an improvement in the general arrangement of flying boats. While normal design is moving slowly through the bog of convention, the ideas which he has been working upon offer, he holds, an avenue of escape from the natural limits which press the designer closely on every hand.

Obituary.

LOUIS ANTHYME HERDT.

THE death is announced, as having taken place on April 11th, of Professor Louis Anthyme Herdt, Macdonald Professor of Electrical Engineering at McGill University, and Vice-President of the Montreal Tramways Commission.

The late Professor Herdt, whose career had been a very active and successful one, was born in France fifty-three years ago. He went to Canada in his early youth, and graduated in electrical engineering at McGill University. Seven years later he obtained a doctor's degree from that college. After leaving McGill he returned to France and engaged in research work at the Laboratoire Centrale, and later studied at the Montefiore Electro-Technical Institute at Liége, Belgium, where he obtained a degree. In 1899 he received the appointment of demonstrator in electrical engineering at McGill, and was later made associate professor. Professor Herdt was considered to be one of the leading electrical engineers of Canada and had a part in many great electrical enterprises. He also wrote a number of papers on various phases of the science of electricity.

Literature.

SHORT NOTICES.

Modern Railway Signalling. By M. G. Tweedie and T. S. Lascelles. London: Blackie and Son, Ltd., 50, Old Bailey, E.C. 4. Price 20s.—Railway signalling is not only an interesting subject, but one that can be readily understood, although it may be difficult to put the knowledge so gained into practice. To railwaymen it is particularly useful at the present time, as the companies are finding that by additional signalling at certain boxes others adjacent can be closed. The present work, being by two signalling authorities, should therefore not only meet the everyday popular demand for books on signalling, but be useful to officers in the operating departments of our railways and to students. Both mechanical and electrical signalling are dealt with. Only about one-quarter of the space is devoted to the former side of the question, and it must be acknowledged that those seventy pages are in distinct contrast to the remainder. In the larger share that deals with track circuit, automatic signalling, the working of single lines, power operation of points and signals, telegraphs, telephones, &c., the authors have done themselves credit. No subject appears to have been omitted and all that has been covered is described clearly, with detail and accompanied by sketches or other illustrations. But the mechanical chapters, though good, are less satisfactory. A large number of the illustrations are obsolete and many examples of modern practice are missing. Fortunately, there is less need to-day for knowledge as to mechanical signalling than there is for electrical signalling, and, as we have said, that part has been exceedingly well done; in fact, it could not be improved.

Fuel Economy and Smoke Prevention. By John B. C. Kershaw. London: Constable and Co., Ltd. 1925. Price 16s.—At the present time renewed interest is being taken in the closely allied questions of fuel economy and the prevention of smoke in our large cities and industrial areas. In connection with this subject few books we know of give a clearer and more connected account of recent fuel economy practice than does this third edition of Booth and Kershaw's "Fuel Economy and Smoke Prevention." Since the second (1911) edition eleven new chapters have been added to the original five, and include sections on such important subjects as fuel grading, washing and storing, and the utilisation of waste heat and waste steam. Other of the new sections of the book describe the boilers and accessory plant which have recently been installed in the large super-power stations of Britain, America and France. The book, which is well arranged and illustrated, should prove of value to fuel users, engineers in charge of boiler plants, and industrial chemists. We associate ourselves with the wish of the author that it may help to raise the general level of thermal efficiency in the smaller steam boiler plants and in doing so contribute in a practical way to the abatement of the smoke nuisance.

The Science of Flight and its Practical Application. By Capt. P. H. Sumner. London: Crosby Lockwood and Son. Price 16s. net.—In this volume the author, lately a staff officer attached to the Air Ministry, discusses airships and kite balloons. In a succeeding volume he will deal with aeroplanes and seaplanes. As a record of what has been done in the construction of airships and kite balloons Captain Sumner's first volume possesses some value, but as a treatise on the scientific aspects of their design and construction the works falls short of the promise suggested by its title. Too much space in a volume of no great size is devoted to the description of past and existing types. Except for their historical interest details of the "Nulli Secundus," the "Beta," and other pre-war airships and of the "blimps," "coastals," "north seas," and other airships of the early war period are of little or no value to the designer of to-day. The most useful part of Captain Sumner's book is undoubtedly that devoted to kite balloons.

A New Electrical Converter.

AT the present time there is a greater demand for apparatus converting between alternating and direct current than ever before. Such converting apparatus usually takes one of three forms :—(1) Rotary converter with transformers ; (2) motor generator ; (3) motor converter. In addition to these, there is, of course, the mercury vapour rectifier, and in small sizes a number of other rectifying devices. The chief characteristic of such apparatus is that the direct-current voltage regulation depends either on the use of transformers or on the employment of two distinct machines, as in the motor generator set. It seems, therefore, that a converting apparatus, consisting of one machine only, capable of being arranged to take alternating current of any voltage, including high-tension supply, without the use of transformers, and at the same time of delivering direct current of any voltage independent of that of the alternating current, should find a wide field of application, and that this field of application would be still further enhanced if it should be possible to arrange the direct-current side so as to have any desired characteristics, series, shunt or compound, or even such special characteristics as are required for welding purposes. The type of machine described in this article, built under Creedy's patents, has been worked out to satisfy these requirements, and is believed to form a type of converting apparatus presenting marked advantages over every other. Some of the more common applications of such an apparatus are as follows :—(1) Charging accumulators ; (2) the operation of projectors at cinema theatres ; (3) the operation of arc lamps for photographic purposes ; (4) arc welding ; (5) the operation of printing presses, where very accurate and gradual speed control is required ; (6) the operation of textile machinery ; (7) automatic sub-stations ; (8) consumer's sub-stations ; (9) operation of lifts ; (10) some types of machine tool operation ; (11) electrolytic processes, medical purposes, as, for instance, supplying tungsten arcs, &c.; (12) many cases where variable speed is required or speeds unattainable with alternating-current motors. Various other applications will present themselves to users of industrial machinery.

The characteristics of the Binary converter closely resemble those of the motor generator, its chief advantage over this apparatus being the much greater compactness and lighter weight, and, above all, the very much increased efficiency, together with the very moderate cost of the Binary converter. The motor generator and the Binary converter are the only known types of apparatus in which the direct-current side can be regulated in a manner entirely independent of the alternating current. In all other types there is a more or less rigid relation between the direct-current and alternating-current voltages. Another advantage of the Binary converter is that the number of poles of the direct-current and alternating-current side are almost entirely independent, so that the speed of the set is not kept low because a large number of poles are desirable for commutation purposes on the direct-current end, nor need it be made undesirably high if it is desired to make the direct-current end with very few poles.

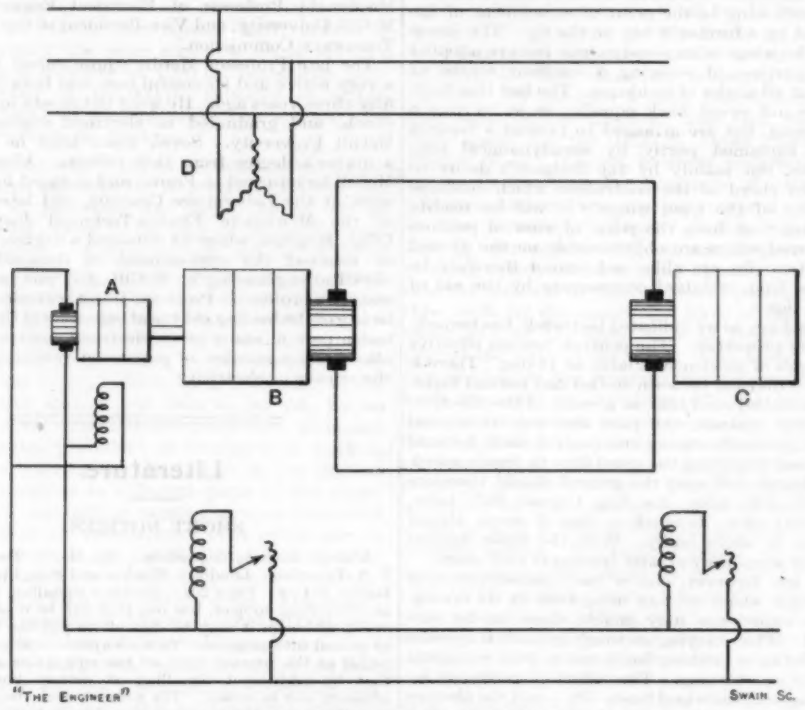


FIG. 1—CONNECTIONS FOR WARD-LEONARD SET

The compact construction of the Binary converter renders possible a single-unit Ward-Leonard set in which the Binary converter is mounted along with a suitable small exciter and a direct-current motor on a common bedplate. This combination is held by many engineers to present advantages, since the whole of the apparatus is contained in a single unit. In other cases, of course, where the direct-current motor has to be placed in a very confined space, it may be more convenient to separate it from the Binary converter, but it may be pointed out that the complete set takes up no more space than a direct-current motor, together with worm gear and pony motor, as often used for driving the press at inching speed, and at the same time it eliminates the extremely elaborate control frequently required, since the control of a Ward-Leonard unit takes place entirely by means of field rheostats. The control circuits are shown in Fig. 1, in which the exciter A—which is required for such applications, so that voltage regulation at the Binary commutator does not vary the voltage across the motor field—is shown mounted on a common shaft with the Binary converter B. It excites the two fields of the Binary converter and of the motor in parallel, the commutators of the two machines being permanently coupled together.

For printing press work the two field rheostats are operated by a small auxiliary motor, which is arranged first of all to cut out the resistances in the converter circuit, thereby raising its voltage to the maximum, and this having been done weakens the field of the motor to obtain still higher speeds. The auxiliary motor which operates these field rheostats is controlled by push buttons mounted on various parts of the press in the usual manner.

For certain purposes the motor has to run at not more than 3 per cent. of its maximum speed, the total speed range therefore being 33–1. By means of the arrangement just described, this very wide speed range can be easily accomplished. Where such extreme speed ranges are not required, regulation of the strength of the motor field may often be omitted, the whole of the control being effected by means of the converter. Some classes of textile machinery, for instance, textile printing machinery, calendaring and dyeing apparatus, requires characteristics of a generally similar nature, though not so severe. The Binary converter is, of course, equally applicable to these purposes.

Another field of application for the Binary converter is in connection with paper-making machinery, where exceptionally close speed regulation is required, such as can best be accomplished by a direct-current motor. It should be pointed out that since the Binary converter, as well as the direct-current motor, can be accurately compounded, very close speed regulation with increasing loads can be offered.

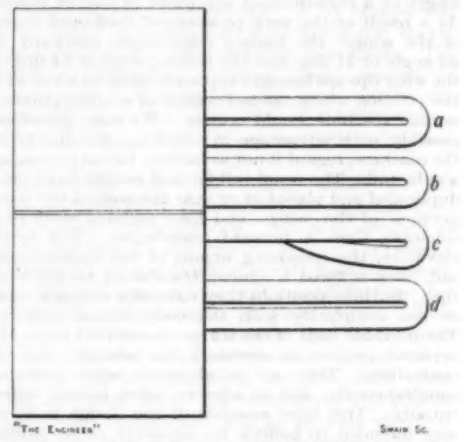


FIG. 3—STATOR AND ROTOR WINDINGS

On account of its very compact construction and the independence of the direct-current and alternating-current sides, together with the absence of synchronisation, the Binary converter is especially adapted for automatic and consumer's sub-stations, where space is an important consideration.

Battery-charging sub-stations for electric vehicles and other purposes are examples of this. The same characteristics render the Binary uniquely adapted for arc-welding sets.

A sectional elevation of the Binary converter is shown in Fig. 2, where it will be seen that it consists of a laminated stator similar to that of an induction motor and mounted in the same way inside a cast iron frame. This laminated stator contains a standard induction motor winding in the space next the air gap and a field winding in the same slots, but completely insulated from the alternating-current winding, there being, as already pointed out, no electrical connection whatever between them. Inside this stator revolves a rotor carrying a direct-current winding attached to a commutator. This winding is exactly the same in nearly all respects as that of a standard direct-current machine, but containing special circuits adapted to carry the secondary current of the induction motor end. It is fitted with standard type brush gear.

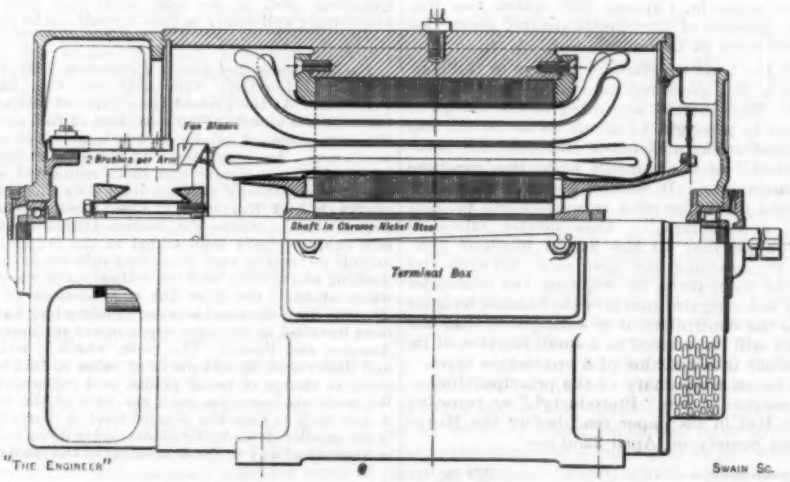


FIG. 2—SECTIONAL ELEVATION OF THE BINARY CONVERTER

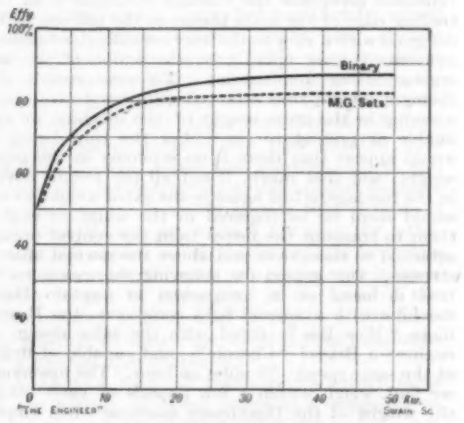


FIG. 4—EFFICIENCY CURVES

The Binary converter may be constructed to work as a synchronous or induction machine, though the latter is usually adopted in the sizes here described. To explain the principle of the machine clearly, it will be convenient to consider the synchronous type first. Consider a machine carrying four windings, two on the stator and two on the rotor, which may be called *a*, *b*, *c*, *d*—Fig. 3. Suppose, for instance, that of the rotor windings *c* and *d*, *c* is arranged for six poles and *d* is a two-pole winding, and of the two stator windings *a* and *b*, *b* is arranged for two poles and *a* is a six-pole field winding. Suppose direct current to circulate in the two-pole field winding *d* on the rotor and suppose the machine to be running at the synchronous speed of this two-pole winding, namely, 3000 revolutions per minute. Clearly the two-pole winding can induce no

voltage in the rotor winding *c*, since it revolves with it, and hence does not cut it. Similarly, if direct-current circulates in the field winding *a* on the stator, clearly this direct current can induce no E.M.F. in the other winding *b* on the same core, since both windings are fixed. This winding *a* induces E.M.F. only in winding *c* and winding *d* induces E.M.F. only in winding *b*. The flux due to winding *d*—stationary with respect to the rotor—will revolve in respect to the stator, while that due to winding *a* cuts the rotor and is stationary with respect to the stator.

If winding *b* is supplied with 50-cycle single-phase or polyphase current, the machine will work as a synchronous motor, and if the winding *c* is joined to a commutator, a direct-current E.M.F. will be produced across that commutator. Winding *d* cannot induce any E.M.F. in winding *a*, since the two are wound for dissimilar number of poles, and for the same reason winding *a* cannot induce any E.M.F. in winding *d*. In practice, the use of two windings on the rotor of such a machine is inconvenient. This is rendered unnecessary if the single rotor winding attached to the commutator is given a pitch which is equally adapted to operate on six or two poles, such, for instance, as the full two-pole pitch which is also equally well suited to six poles, for in both cases north and south poles are diametrically opposite. If this winding is tapped off at points differing by two-pole pitches of the six-pole field—that is, at three points 120 deg. apart—and these points brought out to slip rings, no E.M.F. will be induced by the six-pole flux between any two of these slip rings. If, therefore, a pair of them are short circuited, and direct current inserted between the short-circuited pair and the remaining ring, a two-pole excitation of the rotor may be brought about without requiring the use of a separate winding, and in this way the six-pole and two-pole windings may be combined. Means exist for combining the two separate stator windings also, but it would lead too far to describe them in the present brief article. It will suffice to consider that separate direct-current and alternating-current windings are employed on the stator as is actually the case in the smaller sizes.

The alternating side of the machine may also be caused to operate as an induction motor, if the points which before were connected to slip rings are short circuited together. Under these circumstances, currents of slip frequency will flow through the short-circuited connections and the slip rings may be eliminated. In this case, of course, the short-circuited points need not be limited to three, so long as care is taken that only points two-pole pitches apart of the six-pole field are connected. This type of machine, owing to the absence of slip rings and of the necessity of direct-current excitation of the rotor, is the most suitable for small sizes.

In the induction type of machine it is no longer true to say that one flux is stationary with respect to the rotor and the other with respect to the stator. The flux which is now generated by the alternating-current winding on the stator is in slow rotation with respect to the rotor also. The effect of this slow rotation is to superimpose a tiny ripple of amplitude, perhaps ½ per cent. of that of the direct-current voltage on this voltage, a ripple which is of absolutely no significance. Of course, the machine is not limited to two and six poles, but can be built for many other ratios of poles.

It will next be of interest to describe the practical construction of a machine of small size arranged for two and six poles and converting from three-phase to direct current. Such a small machine is arranged with twenty-four slots in the stator. Six of the slots are devoted to a shunt winding. In order to prevent the two-pole flux inducing very high E.M.F. in the shunt winding, which may have a very large number of turns, it is necessary to ensure that the alternating E.M.F. in the shunt winding shall cancel out turn by turn. For this purpose the winding is made as a single long coil, each turn passing from slot 1 through the whole of the six slots before returning to slot 1, as in Fig. 5. Intermediate between any two adjacent slots of the shunt winding are three other slots. In the parts of those slots next to the air gap a two-pole three-phase winding of the ordinary concentric type is placed, while in the rear of the same slot the interpole winding is placed.

The rotor consists of a direct-current armature of a perfectly normal type, corresponding to that of a two-pole machine and short circuited along a number of points, each two-pole pitches apart, of the alternating-current winding. Such a machine in essence consists of an induction motor driving a direct-current generator, both having common magnetic circuits and common windings. On the direct-current side it has all the characteristics of the direct-current interpole generator:—(1) It can be compounded by moving the brushes off neutral; (2) the direct-current voltage can be regulated by a field rheostat in the usual manner, and it can be started in the same way as any squirrel-cage induction motor, and, of course, does not require synchronising.

The starting gear of the Binary converter is that appropriate to a squirrel-cage induction motor. The smallest polyphase sizes may be switched directly on to the line. For sizes of 1 to 5 kilowatts, three-phase star-delta starters are employed, while in sizes exceeding this it is possible to employ either an auto-transformer starter or a type which has been specially designed for the Binary, which in the starting position inserts a choker in series with the line in order to cut down the voltage supplied to the machine, and in the running position connects the terminals of the machine direct to those of the line. Many supply authorities object to large squirrel-cage motors being connected direct to their line, but it should be pointed out that the Binary converter always starts on absolutely no load, and only has to accelerate its own rotor against the friction of the brushes. It is therefore possible to cut down the starting current of the Binary converter to a very low figure, not exceeding twice full load, or where an auto-transformer starter is used, 1½ times full load. The Binary converter is being built and placed on the market by Mawdsley's, Ltd., of Dursley, Glos., and has been standardised up to 50 kilowatts. In Fig. 4 is shown a curve of the full-load efficiencies of all the sizes, plotted against kilowatt rating.

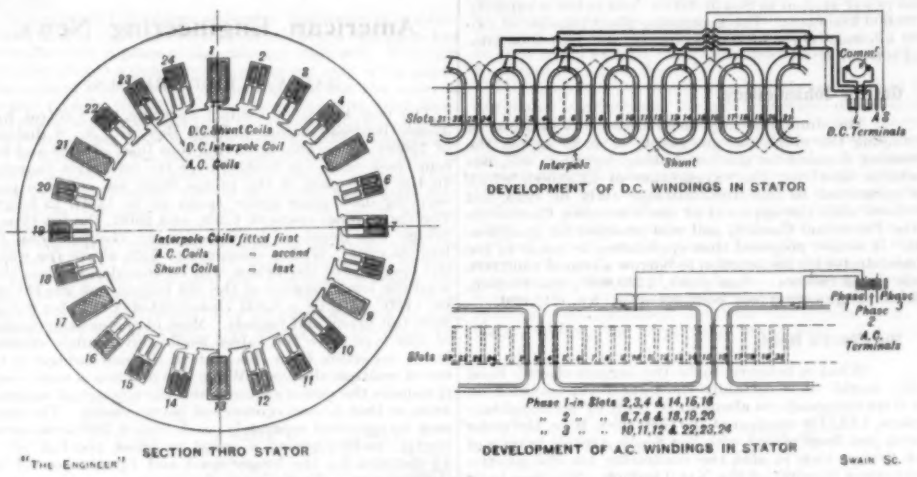
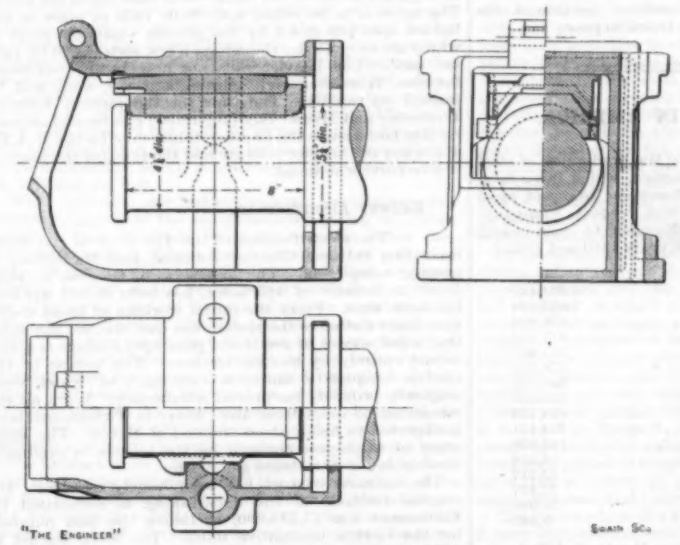


FIG. 5—ARRANGEMENT OF STATOR WINDINGS

Economy in Axle-box Design.

By an ASSISTANT LOCOMOTIVE SUPERINTENDENT.

IT is most certainly necessary to-day that every single suggestion for economy in railway operation or maintenance should be very carefully examined, and it has seemed to the writer that the design of British goods and mineral wagon axle boxes might be modified very considerably in the direction of less first cost, together with possibly cheaper repairs without any loss of efficiency or increase of heated journals. The three diagrams herewith show the general arrangement of a standard American pattern of axle-box for journals of 4¼in. by 8in. suitable for eight-wheeled bogie wagons of up to 15 tons tare and 30 tons capacity, or approximately 5½ tons per axle-box. There would seem to be no reason why this type of axle-box should not be applied to British pattern four-wheeled goods, &c., stock, provided that the weights were kept within the proper limits.



STANDARD AMERICAN AXLE-BOX

The diagrams show a design consisting of a cast steel or cast iron outer box of the usual shape into which is fitted a brass "step" or bearing; a cast iron making up piece, usually known as a "wedge," although not strictly wedge shaped, being fitted in between the outer box and the brass step, its ends being tapered off, as shown in the longitudinal section, in order to allow of a certain amount of "rock." The bottom of the axle-box is formed hollow, and is known as the "cellar," and is utilised to contain the lubricating medium, which is usually clean waste heavily steeped in lubricating oil.

With these axle-boxes machine work in manufacture is reduced to a minimum. In the outer box itself the only machining done is the drilling of the hole for the spindle on which the axle-box lid is hinged, the spindle being a plain bolt, nut and split pin. The diagrams do not show the lid, which consists of a steel stamping shaped to cover the mouth of the box on to which one end of a flat steel spring is riveted, the other end of the spring bearing against a lug cast integral with the box which holds the hinge spindle for the lid; and on which lug a cam-shaped ridge tends to hold the spring and thus the lid in a "shut" position.

The wedge is a plain iron casting not machined in any way, its upper face being mainly flat and bearing against the axle-box casting, the lower face being formed part hexagonal—as shown in the cross section—to suit the outer side of the step. When in position the wedge butts against a lip cast in the axle-box at its outer end only. The step is machined on its journal face only, the rest being a foundry finish. Looking at the lower half of the plan, the step will be seen to have lugs cast on each side intended to bear against vertical ribs cast in the axle-box casting; the longitudinal section shows the lip formed on the inner edge of the step fitting snugly against the end of the wedge. The axle cannot therefore work out of the axle-box as it is held in one direction by the lip on the axle-box and in the other by the lugs on the step.

The best method of machining the steps is to bore them out a pair at a time in a special horizontal boring machine having three tools fitted in the boring bar; namely, a plain boring tool in the middle and two correctly radiused tools, one at each end, which can be brought into use by hand after the parallel boring has been completed. The steps have then an ordinary piece of sheet lead, cut from lead weighing 5 lb. per square foot—about ¼in. in thickness—soldered on to their journal face; the lead is then roughly bedded on to the journal of the axle, and the step put into place in its box, the whole being then ready for ordinary service. In a short period of time the lead gets worn down and a face becomes formed automatically on the brass itself of the step without any heating or any other trouble. The usual U-shaped piece of hard wood is fitted into the slots at the back of the axle-box for the exclusion of dirt, &c.

As already mentioned, the lubrication is usually performed by means of oil-soaked waste rammed fairly tightly into the axle-box cellar underneath the journal and in contact with it. The waste need only be ordinary cleaned cotton waste of a good quality, and it is prepared by being first well teased out and then submerged in the lubricating oil for about forty-eight hours in a permeating tank, after which it is laid on a grid and the surplus oil allowed to drain off. The quantity of oil that should be allowed to remain in the waste is about 3½ to 4 pints of lubricating oil per pound of waste, and at this quantity it is ready for use in the axle-boxes. The prepared waste is usually rammed into the cellars by means of steel rammers with flat ends of about ¾in. by ¼in. section, the rammers being slightly bent to conform with the lower outline of the cellars. A good way of packing the oily waste into the cellars is to twist it into a "rope" and lay it to and fro at right angles to the axis of the journal, taking care to push it well home with the rammer and to fill up all corners and crevices. It is, however, sufficient for ordinary usage if the waste be rammed in *en masse* up to about the centre line of the journal, and this is perhaps the cheaper way.

The ordinary attention that axle-boxes packed in the foregoing manner receive on the writer's railway is to loosen out the waste and repack it after every 1000 miles run in the case of passenger vehicles, and when the greasers get an opportunity in the case of cargo vehicles. A very good guide is to examine the outer portion of the waste and, if the part next to the journal shows a glazed appearance, all of it should be pulled out and loosened or renewed, as experience may dictate. If otherwise in appearance, it may be allowed to continue in service.

The great disadvantage on a Colonial railway of this method of axle-box lubrication is the ease with which the native bullock-cart drivers can steal the waste while the wagons are standing at wayside stations and sidings, the which they do in order to lubricate the axles of their own carts. Hot axle-boxes on the railway can frequently be definitely traced to stolen lubricating waste, but one would hardly experience this trouble in Great Britain.

The steps can easily and quickly be removed for renewal or examination by just taking the weight of the wagon off the step desired by means of a small screw bottle-jack placed underneath the axle-box, a lift of about 1in. to 1¼in. with the jack being enough to allow of the withdrawal of the step and the wedge. The standard bogie for cargo vehicles on the writer's railway is of the ordinary "arch-bar" pattern, and the time allowed to a gang of two wagon-lifters for changing either an inner or an outer pair of wheels and refitting the steps to the new journals is one hour per gang. The price is arranged to cover either inners or outers, the gangs taking pot luck as to which require attention, and the average balance made over time rates works out at about 40 per cent. additional to ordinary time. It is obvious that changing inners is a

much longer job than changing outers, as in the latter case only the weight of the axle-boxes of the defective axle need be taken in order to allow of the removal of the axle; while in the former case, the whole wagon body must be lifted in order that the bogie may be rolled from under the wagon, after which the axle can be changed.

SIXTY YEARS AGO.

Slowly but surely the Government of this country was, sixty years ago, beginning to stir itself in the matter of legislation in matters affecting public safety. Many disasters and mishaps in a wide variety of directions had called forth loud cries from the public and the Press for stricter control by the Government of undertakings involving a menace to the safety of the community. Ships and railways, gasworks and waterworks had, following some recent serious disasters, particularly engaged public attention in 1866, but the Government, as we put it in our issue of April 27th of that year, had been placed in a most difficult position by the bitter attacks of those commercial Hampdens who resented all forms of interference. The campaign for the protection of life was, however, making progress in spite of opposition and lethargy. The terrible disaster to a large reservoir belonging to the Sheffield Waterworks Company, whereby a year or so previously several hundreds of lives had been lost, a disaster which differed only in the magnitude of the death roll from several similar previous accidents, had under the pressure of public opinion led to the introduction by the Government of a stringent Act for the safe management of water reservoirs. By the provisions of this Act the onus of proof of negligence was not to be placed on the sufferers by an accident. The mere fact of the failure of a reservoir was presupposed to show negligence on the part of the owners. That such a clause was necessary is shown by the fact that the absence of such a stipulation made it impossible to fix the legal blame on any person for the failure of the Holmfirth Reservoir in 1852, and all but came to the rescue of the Sheffield company in 1865. Under the Act no reservoir of a million cubic feet capacity or upwards could be filled without written notice being given to the Board of Trade and without an inspection by and certificate from that body. The penalty for filling the reservoir without authorisation was £100, plus £50 for every day it was kept filled. If the reservoir were filled after the Board's report had stated that it was dangerous to do so, the penalty was to be £500, plus £100 per day. In the case of existing reservoirs the Board was given power to order an inspection if at any time it seemed expedient to do so on the grounds of public safety. If danger were found to be imminent the Board could order or itself undertake the lowering of the water level. In another matter affecting public safety Parliament was also moving, although in this case it was a private member's and not a Government Bill that was in question. The murder of Mr. Briggs on the North London Railway was still a subject of alarm among the travelling public. Other incidents, such as the loss of a tire, a carriage on fire, and so on, in which passengers unable to communicate with the guard or driver, had to suffer an unenviable imprisonment until the train reached its next station, had raised an insistent public demand for the provision of some means of communication between the passengers and the staff of trains. Two members of Parliament had introduced a Bill under which all the railway companies were required to provide means of communication between passengers and guard and between guard and driver on all their trains within a period of three months. Failure to comply with this requirement was to render the company liable to a penalty of £5 for each journey of each carriage unprovided with the means of communication specified. We can find no record of the fate of this Bill, and can only presume that it failed to pass.

RAIL PRODUCTION IN AMERICA.

The following statistics covering the production of steel rails in the United States of America, which have been drawn from the records of the American Iron and Steel Institute by the United States Steel Products Company, indicate the change over from Bessemer to open-hearth steel which took place between the years 1910 and 1925:—

Years.	Open-hearth.	Bessemer.
1910	1,751,359	1,884,442
1911	1,676,923	1,053,420
1912	2,105,144	1,099,926
1913	2,527,710	817,591
1914	1,525,851	323,897
1915	1,775,168	326,952
1916	2,269,609	440,092
1917	2,292,197	533,325
1918	1,945,443	494,193
1919	1,893,250	214,121
1920	2,334,222	142,899
1921	2,027,215	55,559
1922	2,033,000	22,317
1923	2,738,779	25,877
1924	2,307,533	16,069
1925	2,691,823	9,687

In the total for rail production in the United States in 1925, 83,747 tons of re-rolled rails are included, and the net production of new steel rails was 2,701,510 tons.

A further analysis shows that as regards weight per yard and quality, the total of 2,701,510 tons produced in 1925 was made up thus:—

Rails.	Open-hearth.	Bessemer.
100 lb. per yard and over	1,636,228	403
85 lb. to 99 lb. per yard	750,783	25
50 lb. to 84 lb. per yard	212,310	5,611
Under 50 lb. per yard	92,502	3,648

Generally speaking, railways in the United States use 85 lb. rails, but consideration is being given by some lines, such as the Pennsylvania, to the adoption of rails weighing 150 lb. per yard.

South African Engineering Notes.

Power Station Mishap.

One of the 6000-kilowatt machines in the power station of the Randfontein Estates Mine, on the Rand, has recently had a total breakdown. The repairs were estimated to take four months, but the company hoped to have the new 12,000-kilowatt machine at work in ten weeks. It is estimated that the output of the mine for the month of March would be affected to the extent of 12,000 tons, and development restricted. It was believed, however, that the April output would not be seriously affected. The mishap adds another to the chapter of accidents at the gold mines of the Rand quite recently; an accident in the Cassen shaft of the E.R.P.M. having decreased that mine's output by 15,000 tons, while a winding mishap at the Van Ryn Estates, in which several natives were killed or injured, will affect that mine's output, though to what extent has not yet been notified.

The Randfontein Power Station is the largest single mine power station in South Africa, and it has a capacity of 20,000 kilowatts. The generating plant consists of two 1000 kilowatt, three of 2000 kilowatt, and two 6000-kilowatt sets.

Gas for Johannesburg.

The Johannesburg Town Council is desirous of developing the municipal gas plant, so as to supply the increasing demand for gas for cooking, lighting, &c., but a scheme involving the expenditure of £350,000, which was submitted to the Administrator early in 1925, did not meet with the approval of the Executive Committee of the Provincial Council, and was returned for modification. It is now proposed that application be made to the Administrator for his sanction to borrow a sum of £300,000, made up as follows:—Gas plant, £220,000; distribution, £65,000; engineering fees, contingencies, &c., £15,000.

Big Electric Hoist.

What is believed to be the biggest electric hoist in the world—it is certainly the largest yet installed on the Witwatersrand—is about to be built by Metropolitan-Vickers, Ltd., for erection at the City Deep Mine, the order having just been placed with the South African branch of that firm, which is also the contractor for the electric locomotives running on the Natal section. The new hoist will consist of two cylindro-conical drums measuring 15ft. in diameter at one end and 35ft. in diameter at the other. To these drums there will be direct coupled two electric motors, each rated at 2400 horse-power. The hoist will run normally at a speed of 33 revolutions per minute, winding from a distance of 4500ft. a load of 10 tons of rock. The hoist is primarily designed to raise ore. A steel rope over 2¼in. in diameter is used. It may be stated that the last four or five big winding equipments installed on the Rand have been supplied by the same firm, which is very successfully meeting the keen American and continental competition that exists for the business to be obtained from the Witwatersrand.

New Cape Central Railway.

The Union Railway Administration is going to spend £100,000 in reconditioning the New Cape Central Railway, which was purchased by the Union Government during the parliamentary session of 1925, and was formally taken over by the South African Railways on August 1st. Under Union control the line will form part of what will be regarded as one of the finest scenic railways in the world. The track is to be relaid with 80 lb. rails in place of the lighter ones put down by the private company, most of which are only 45 lb., though on a few sections 60 lb. rails are used. The heavier rails are now being distributed between Worcester and Ashton, and the work will be pushed on rapidly. The time for the journey between Worcester and Mussel Bay (209 miles) has been shortened by five hours since the line was taken over by the R.A.R., and when the heavier rails are laid the time for the journey will be further reduced.

Railway Electrification.

The electrification of the 176 miles of the Natal main line between Glencoe Junction and Maritzburg is nearing completion. The first section, Glencoe to Mooi River, a distance of 113 miles, has been in full working for some time. From the initial working of small trains over short distances the system has now reached the stage that a full service of goods and passenger haulage is maintained entirely by electric traction. The testing of the electric locomotive units, seventy-eight of which were originally ordered, has proved satisfactory. Work on the remaining 63 miles from Mooi River to Pietermaritzburg is expected to finish about the end of March. The small army of employees engaged on the scheme is gradually diminishing as the stages get shorter.

The estimate of cost has been largely exceeded; the original estimate of the undertaking as authorised by Parliament was £3,318,990, excluding the sum required for the electric locomotive units. The work started in 1922, but two years later, according to the White Papers presented to both Houses of Parliament, it was found that £4,387,334 would be necessary to complete the scheme. A comparison worth noting is that the electric trains haul 1430 tons at 23 miles per hour up certain maximum gradients of 1 in 65; the steam trains of half that tonnage travel over the same section and gradients at about 7 to 8 miles an hour. The expansion of traffic under these new conditions will be very great owing to the much larger daily tonnage capacity. This is already shown in the returns for 1925. Since electric working was begun the volume of traffic has increased considerably. In August last the tonnage conveyed coastwards totalled 685,573, an average of 22,123 tons per day. From September 1st to 19th no less than 424,538 tons had been despatched, giving an average of 22,344 tons daily. The maximum tonnage hauled in any one day was 27,179. This is an assurance that the electric locomotives are doing the work expected of them, and that no difficulty has been experienced in handling the loads specified.

What may account for a large percentage of the increase on original estimated expenditure is the fact that, although the route mileage of this scheme is set down at 175 miles, there have been so many further facilities added from time to time to the original survey, which really reached 244 miles, that the construction finally worked out at approximately 309 single miles of track. The load on the power station has steadily increased from the date of the inception of electric traction, which was October 9th, 1924. For operating the whole of the traffic between Glencoe and Mooi River, a distance of 113 miles, about 250,000 units are sent out daily. On the unfinished stage between Mooi River and Maritzburg there are already four electric trains running daily between Mooi River and Nottingham Road, and one on to Balgowan from Nottingham Road. There has been no serious failure of power supply to the system caused by any defect in the electrical machinery installed in either the power station or sub-stations.

American Engineering News.

RAILWAY LIFT BRIDGES.

The new bridge or viaduct carrying the Central New Jersey Railroad across Newark Bay, U.S.A., a distance of 7500ft., is notable in having four lines of rails and two four-track cable lift bridges over the navigable channels. In the main part of the bridge there are concrete piers carrying deck plate girder spans up to 125ft. in length. For the channel spans of 125ft. and 200ft. the lift type of bridge was found to be considerably cheaper than the bascule type. With a clearance of 35ft. above the water, the openings of the bridge will be considerably less than with the low clearance of the old bridge, and the lift will be 115ft. to give a total clearance of 150ft. for vessels with tall masts and funnels. Most of the existing bridges of this type have the cables leading over single sheaves, but a departure from this plan in the new bridges is the use of multiple sheaves. While this practice is more costly it reduces the power required and the amount of maintenance, so that it is an economical improvement. The spans may be operated separately, each with a 200 horse-power electric motor, giving a speed to effect the full lift in 1¼ minutes for the longer span and 1¼ minutes for the shorter span. Traffic over this bridge amounts to more than 300 trains daily.

MACHINE OPERATION OF A COAL MINE.

Electric drills, electric loading machines and electric locomotives in the Acme Mine, in Wyoming, U.S.A., have replaced about 275 loaders and horse traction. There are three working sections, each with four loading machines. Eight of them are large machines working in the rooms, and each loading nearly 200 tons per day. The others are smaller machines handling the coal mined in entries and room necks and averaging about 160 tons per day. The rooms are now made 350ft. long, instead of 250ft. as with hand loading. They are also 26ft. wide instead of 22ft., the latter not giving sufficient width for proper working of the loader. The 3-ton mine cars have been made wider and higher for increased capacity. An ample supply of cars is needed, as the room machine will load eighteen or twenty cars in an hour. The machine crew of eight men does the entire work of undercutting, drilling, blasting and trimming. Electric drills finish holes in 2 minutes, where hand drilling required 15 to 20 minutes. Only light shots are fired, but blasting is done when only the shot firing men are in the workings. The larger machine, travelling on rails, has a scoop or bucket on a long arm, picking up a load of about 1200 lb. of coal and placing it in the wagon. The lighter machine travels on endless chain bearings of the caterpillar type, and its loading device delivers the coal to an inclined conveyor mounted on a jib, the upper end of which projects over the mine wagon.

ECONOMY IN TURBINE PLANTS.

Better and more economical arrangement of steam turbines and auxiliaries in power station has been suggested as a result of studies made by *American Power* as to the production cost of steam power. It appears that fixed charges per unit of power output are on the increase, although fuel and labour costs are decreasing. Some reduction in this unit first cost may be effected by increasing the capacity of standard turbines by means of multiple bleeding, and also by the use of hydrogen as a cooling medium in the generator. In large central power stations there is usually a large volume of unoccupied space in the turbine room, since building cost is a large element in first cost, and is closely related to the volume enclosed, any reduction in height of turbine room would reduce volume and first cost. The turbine itself is set on expensive foundations, extending 30ft. or 40ft. above the basement floor, and space must be left above it for lifting the cover and the spindle. It is customary to place the condenser below the turbine, but there is no thermo-dynamic advantage in this arrangement. If vertical condensers were used, and the turbine exhaust were taken out of the side or top of the turbine casing, as in marine practice, the foundations need be only 6ft. or 8ft. high, and might be of solid concrete. Overhead space for drawing out the condenser tubes would govern the interior height of turbine room, but the room could then be made narrower, with auxiliaries compactly arranged on the floor space, and accessible from the turbine platform so as to simplify operation.

The new escalators at Trafalgar Square Station on the Baker-street and Waterloo Railway have now been opened and the lifts closed. The space occupied by the latter will now be devoted to a new and larger booking hall, which will be able to deal with 8,000,000 passengers a year instead of the former 4,000,000.

Modern Development of Paper-mill Plant.*

By W. WORBY BEAUMONT and LESLIE N. BURT, Members.

(*Concluded from page 477*)

Press Rolls.—After leaving the couch rolls (A A), Fig. 2, the paper is too weak to sustain its own weight for any distance, resembling wet blotting paper, and is therefore transferred over a gap to a felt for its next stage and carried thereon through the first press (B B). The press rolls are heavy plain rolls of cast iron, sometimes brass covered, their purpose being to squeeze out as much water as possible and to consolidate the paper. As the felt is carrying the paper, as it passes through the press, one face only is smoothed by the action of the rolls, the other side still retaining the marks of the wire and felt. To remove these a second press is required, but to present the opposite face to the smoothing action of the roll a second felt is introduced, which transfers the paper backward through the rolls.

In high-speed machines a third or fourth press is introduced, and in some cases the lower roll of the first press has a vacuum roll in place of the ordinary plain roll. This last practice affords a dual advantage, as not only is the paper discouraged from sticking to the top roll, but the water is sucked rapidly through the felt together with such fibre and filling as have parted from the paper, thus keeping the felt cleaner than when running under the older conditions.

The duty that the felts are called upon to perform is somewhat arduous and their life is necessarily limited. They need to be sufficiently porous to absorb the water, free enough to relinquish it at the right time, yet to have a surface that will not mark the face of the paper, and tough enough to resist the pressure of the rolls—perhaps as much as 6 or 7 tons. In order that the felts shall be kept in good condition and give the maximum working life they are made as long as possible so that the work they have to do is distributed over as large an area as can conveniently be arranged, and means are provided for

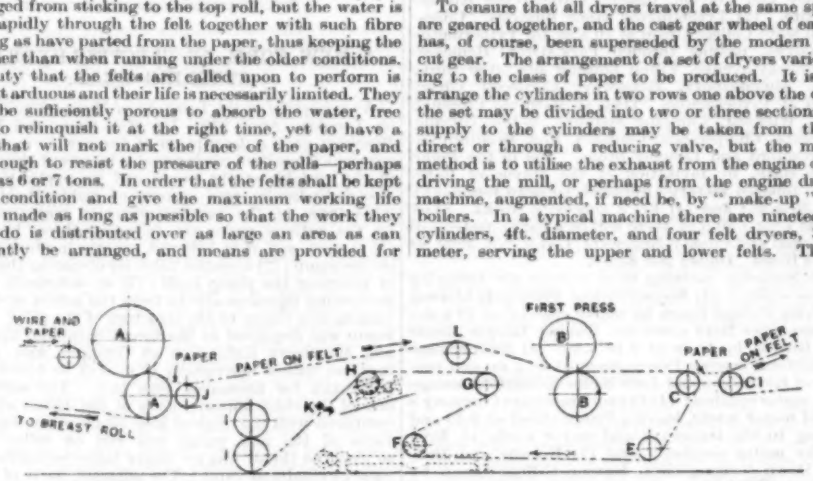


FIG. 2—LEAD OF PAPER TO PRESS ROLLS

washing and drying as the process of manufacture is carried out.

In some mills there may still be found a "flogging" roll, generally cruciform in section, which, revolving rapidly against the travelling felt, beats the water out, some of the dirt, and shortens the life of the felt.

It is necessary that the paper be reversed before drying, in order that the face which has been in contact with the felt may be smoothed by the action of the press roll. Modern high-speed news machines do not always reverse the paper, but run straight through to the dryers, depending for finish on the ensuing operations, apparently with sufficient success to make a readily saleable paper. The difference, however, between the two sides of a sheet of newsprint paper thus made is easily observable. Although jets of water are used constantly playing on the felt during its return journey from the press rolls, the water being squeezed out by a pair of rolls before it again comes in contact with the web of paper, there is a disadvantage in this method that, although the spray may remove all the dirt and portions of stuff, the felt suffers because it is subjected to double pressing, that of the wet press and, secondly, that of the squeezing rolls.

A more recent development which is working in many mills both in this country and abroad is the Vickery conditioner and cleaner, which automatically cleans the felt while paper is being made, and at the same time restores or renovates the felts after their maltreatment by the presses, tension rolls and other gear. The action is as follows:—A cleaning box—in wide machines more than one may be employed—continuously traverses from one side of the paper machine to the other on a girder which is bolted to the side frames. The felt on its return journey passes (right to left) over the top of the "cleaning box," and a jet of cold water and a jet of steam is forced into the felt at a considerable pressure. Immediately the felt has passed the jet plate it comes under the action of a vacuum pipe and chamber, so that the water from the spray is only momentarily imprisoned in the felt, that portion of the felt immediately at any instant above the vacuum box being somewhat drier than its surroundings. By the time it has reached the press, however, capillary action has caused the local dryness to disappear. A brush which, with the help of the hot water, renaps the felt, is provided. The cleaner is intended for cyclical operation.

It may be in the near future, as the speeds of paper machines are increased and the timing of the various elements comprising the machine is rendered still more accurate, that the use of the felt, as a carrier of the paper through the press rolls, will no longer be needed, because the felt would then merely pass the paper from couch roll to press and from one press to another. Its life would be still further prolonged. Many experienced paper-makers hold that there is no fabric save a woven wool felt that will act as a carrier belt, absorb the water from the paper, withstand the destructive action of the presses, and at the same time freely part with the water as required. It must, however, be remembered that what is requisite and necessary in slow-speed running (on which felt makers have perfected their fabric), does not necessarily become insistent at high speeds, and it may be that successive passes through presses, one roll of which is a vacuum roll with possibly air strippers or doctors, will prove a solution of the felt question.

Smoothing Rolls.—In some modern machines making paper requiring a good surface finish a pair of rolls is introduced between the last press and the drying cylinders, the object of which is to close up the fibres of the paper and incidentally to strengthen it while yet wet, before coming in contact with the heated surface of the drying cylinders. The upper roll, around which the paper is led before passing between the two, is covered with rubber, the lower roll being of bronze or of iron with a bronze casing. No felt is used, and if the rubber is of suitable quality and finish all marks of the wire or felts are obliterated.

Drying Cylinders.—In general appearance there is little change between the drying cylinders of to-day and those of forty years ago, except that they are of greater length and diameter, but in the construction, gearing, and auxiliaries considerable improvements have been effected. Cast iron is still found the most suitable material for the cylinders, and the large castings now necessary are excellent specimens of the ironfounder's craft. The shell is bored, turned, and afterwards polished, so that no spongy or porous metal can escape rejection. It must be truly balanced and the thickness of the wall equal at all parts, so as to avoid uneven expansion under steam pressure and to ensure even heat flow.

To ensure that all dryers travel at the same speed they are geared together, and the cast gear wheel of earlier days has, of course, been superseded by the modern machine-cut gear. The arrangement of a set of dryers varies according to the class of paper to be produced. It is usual to arrange the cylinders in two rows one above the other, but the set may be divided into two or three sections. Steam supply to the cylinders may be taken from the boilers direct or through a reducing valve, but the most usual method is to utilise the exhaust from the engine or turbine driving the mill, or perhaps from the engine driving the machine, augmented, if need be, by "make-up" from the boilers. In a typical machine there are nineteen drying cylinders, 4ft. diameter, and four felt dryers, 30in. diameter, serving the upper and lower felts. The drying cylinders are divided into three sets, with a separate drive to each. Two sets are placed before the smoothing rolls, and one after them, so that the speed adjustment is a simple one.

European machine builders, except perhaps in the case of newsprint machines, prefer to divide the dryers into sets, each set having a separate drive and separate top and bottom felts, with their own tensioning gear and dryers. By this construction the speed of the dryers can be adjusted to suit the shrinkage of the paper as it loses its moisture, and the felts, being comparatively short, are more easily adjusted for tension. The life of the felt is also improved, as the changes of condition due to moisture are less extreme, whereas in the single long felt each portion experiences the full range of moisture and temperature of the paper. Another reason for sectional drive is the increased facility in starting up the dryers from cold. From various tests that have been made on different machines it appears that the evaporative efficiency of a stack of drying cylinders is not satisfactory, from 3 lb. to 4 lb. of steam being taken to dry 1 lb. of paper. Average practice would probably show that from 30 per cent. to 40 per cent. of the steam heat supplied to the cylinders is lost in radiation or rejected in the condensate, and it is not easy to devise a method of diminishing the loss.

Wide cylinders are naturally more economical than narrow cylinders of the same diameter, owing to surface radiation from the ends being the same in either case. One of the sources of heat loss is found in that portion of the cylinder which is uncovered either by felt or paper. Another is, that as the paper passes partially dried from one cylinder to another its rate of vapour rejection falls, owing to its passage through the moisture precedently emitted by the paper, and this has to be re-evaporated by the next cylinder. The whole of the water vapour escaping from the paper is discharged into the machine house, and should be removed as speedily as possible, not only because its presence retards the drying of the paper, but because any condensate of this vapour falling from the roof on to the paper in its course will leave spots in the finished sheet. Many machines have a roof or hood over the drying cylinders, from the apex of which ducts are led to exhausting fans, which draw off the moist air and discharge it outside the building. As the moist air passes away fresh air must be introduced to take its place, and if this is of lower temperature than the surface of the cylinders there is a corresponding heat loss, which may be somewhat minimised by the introduction of heated air from a duct in the roof and by other arrangements.

Some rather extensive experiments carried out by the authors showed conclusively that drying was accelerated by removal of the vapour by suction at the expense of increased steam consumption, due to the inflow of cold air to the drying chamber. Further experiments showed that if the drying cylinders were enclosed in a chamber supplied with heated air at such a rate that the whole chamber was slightly below atmospheric pressure, the drying was further accelerated, but unless there were reasons other than mere drying, as, for example, the recovery of volatile constituents from impregnated paper, the use of an enclosed chamber did not justify the expense involved in the additional apparatus required.

These experiments were made on a very slow-running machine and whether it would be possible or expedient in laying out a new mill designed for high-speed production to effect the early stages of the drying in a vacuum chamber appears to be worth consideration. It is not possible to hasten the evaporation of the moisture by increasing the temperature of the first set of cylinders because of damage to the paper by scorching or cockling, but if the operation took place in a vacuum less heat would be needed, as the vacuum increased. The mechanical difficulties of getting the paper into the chamber and sealing the inlet and outlet are not insuperable; similar appliances are used in the textile trade, but in the authors' opinion the whole apparatus would be more applicable to a modern board machine.

It might be pertinent to remark on the neglect of the steam meter by plant engineers. The relation between the steam required for the power plant and the heat required in the processes needs the most careful investigation and each particular case must be considered in relation to the special circumstances controlling it. Interest on capital and provision for depreciation and cost of renewals are quite as important in production costs as the various items which come under the head of running expenses. The construction of the building in which the machine is housed has a very considerable influence on the action of the dryers and their efficiency. Ample window space is very desirable, but in winter this involves considerable heat loss, so much so that double windows with an air space between them is worth consideration. Modern machines as a general rule have a cellar below the machine floor and the felts from the dryer can advantageously be taken below to their felt dryers. In such cases arrangements should be made to remove the moist air and vapour at that level. It is little use drying the felts if the moisture from them is left to be re-absorbed in the paper or to rise and condense on the roof.

Another point that requires study is the ventilation of the machine room, having regard to the health and comfort of the operatives. The standard requirements as to the air being changed entirely in so many minutes have no bearing on the question, and the governing factor must be the amount of moisture to be removed. Other and no less important details affecting the efficiency of the drying plant are the supply of steam to the cylinders, its control, whether automatic or by thermostat, its distribution, whether to groups of cylinders or individually, removal of the condensate and the possibility of the recovery of rejected heat. These matters are of the greatest importance and complexity. Precise data as to the results obtained from plants under actual working conditions are hard to obtain and hard to correlate.

It is usual to employ steam at a pressure of from 10 lb. to 15 lb. in the cylinders, and some writers have assumed that it is essential that the heat supply to the paper must be equal to the latent heat of evaporation of the water which must be removed from the sheet; that is, in effect, to say that the water must be removed by boiling. Further, it has been assumed that the vapour thrown off from the sheet under these conditions could only be removed by air heated to a correspondingly high temperature. Apart from any interference with the proper sizing of the sheet by the use of such high temperatures, these assumptions need a little reconsideration. Water may be evaporated at any temperature, even below 32 deg. Fah., provided that the air be in motion over its surface and is not saturated, but clearly it would be uneconomical to expose the cylinders to cold air as the rate of condensation within the cylinder would be greatly increased and the resultant steam consumption high.

It would seem that generally too much reliance has been placed on cylinder surface heating at high temperature, and insufficient provision made for encouraging the evaporation of the heated moisture by removing its evaporate by ample moisture removing air currents.

Calendering.—The final operation in the process is that of calendering, which completes the finished paper, although papers for special purposes may undergo further treatment according to the use for which they are intended before they are ready for the market. The calender, or the calender stack as it is sometimes called, consists of two side frames carrying bearings in which rotate a number of rolls between which the paper passes. The precise number depends on the finish desired and the speed at which the paper travels. The paper, as it leaves the drying cylinders, still bears the marks of the wire and the felts, and the purpose of the calendering is to eliminate these and as far as possible give the sheet a similar appearance on both faces. In effecting this the thickness of the sheet is reduced and the strength increased.

In machines with smoothing rolls, before the last set of drying cylinders, part of this work is performed before the paper is dried, and the final finish left to the calenders, but in paper on which a glossy surface and close finish is desired it is customary to reel the paper after leaving the calenders, transport it to another house and subject it to the action of a super calender. These are heavier than the machine calender and, being driven independently, can be speeded to give any degree of finish. To assist in consolidating and closing the fibres on the faces of the paper it is usual to damp it, sometimes immediately before it passes through the calenders, but frequently the roll is unwound, passed through a damping machine, re-reeled to allow the moisture to penetrate, and after standing is again unwound and passed through the super calenders.

The construction of a modern stack of calenders requires a very high class of workmanship and accurate finish, as calendering being the final operation, any blemishes in the sheet cannot be rectified by subsequent operations. Power is delivered to the bottom roll, the remainder being friction driven. As a result the weight of all the rolls when operating is carried by the bottom roll in addition to any extra pressure which may be applied by the weights and levers. For this reason the bottom roll is crowned or cambered to compensate for any deflection caused by the load, and it may be necessary to perform the same operation on the upper rolls or on some of them otherwise, pinching at the edges of the web may occur.

If the rolls be steam heated distortion is likely to happen from unequal expansion, and this may be counteracted by blowing cold air on to the parts affected. To keep the rolls clean and to remove any particles of paper dust or broke that might adhere to them, "doctors" are fitted in most machines. These are knife or bevel-edged plates, carried on a rigid bearer and inclined tangentially to the

* The Institution of Mechanical Engineers, April 16th. Abridged.

surface of the roll, and bearing, under light spring pressure, upon it. Conditions occasionally arise which prevent the perfectly true running of one or other roll, or its running in absolute parallelism with the others, or heat may cause distortion, or the roll may be lifted unequally at the ends. Hence constant attention is required to ensure that the doctor blade bears equally, sufficiently close to remove any specks, but not hard enough to score the surface of the roll. It should be observed that if one end of the roll be lifted higher than the other, the edge of the doctor blade would need to follow a spiral curve to keep in contact with it.

Reel-up.—After passing through the calenders the process of paper manufacture is complete, that is, the "stuff" has become paper and the work of the "machine" is finished, any additional treatment depending on the purpose for which the paper is intended, and may be looked upon as a treatment rather than manufacture. As, however, the paper has to be transported whatever its ultimate destination, it must be "reeled," that is, wound up as tightly and smoothly as possible in order to occupy the minimum space and to avoid damage during transit.

Reelers can be divided into two classes: those which are gear driven and those in which the reel itself forms part of the driving gear, for short "drum reels." In the first-named the reel spindle carries a pinion which can be dropped into mesh with a gear wheel driven by belt, motor, or in the "Fougner" machine by a Pelton wheel. In the second class the "reel" spindle is not driven. The whole length of the reel itself rests on a revolving drum which frictionalty transmits its motion to the reel through the paper which is being reeled.

As the paper must be wound under even tension and is delivered from the paper machine at constant speed, it follows that, as the diameter of the reel increases its revolutions must decrease. This decrease occurs automatically in the "drum" machines, but in the reel spindle driven type a slipping clutch is interposed between the source of power and the gear wheel with which the spindle gear meshes. This slipping clutch allows the speed to vary if the tension in the paper becomes excessive. In some cases the drive is by a slack belt, brought to the required tension by a roller running in a weighted pivoted arm.

Machine Drive.—In laying out the driving plan and arrangement of a machine, not only has the case of operation and control to be considered, but the necessity of removing a roll or cylinder with a minimum of disturbance or dislocation of adjacent gear. The provision of a basement or cellar undoubtedly is admirable for meeting these requirements, as not only can the greater part of the driving gear be placed there, but accommodation can also be found for steam and water pipes or felt dryers and their gear.

The use of electric motors for the machine drive has, without question, very many advantages over belt or rope drives, provided the speed of the machine is sufficiently high to render complicated reduction gear unnecessary between the motors and the machine shafts. Even in machines of low speed it may be advantageous to substitute electric driving with a modern high efficiency reduction gear, so as to secure the smoother running and ease of control.

As very many of the largest and fastest modern machines are electrically driven it seems hardly worth while to set out here the reasons for and against electric drive for machines of this class, especially as the *pros* and *cons* have been the subject of many other papers and debates; but it must be remembered that in many instances where electric driving has been adopted in displacement of apparently successful methods, the resulting commercial efficiency has been sufficiently high to outweigh heavier capital outlay and lower electro-mechanical efficiency. In other words, a higher cost per horse-power hour may result in bigger dividends.

One of the many advantages of electric driving is in the case of control; speeds can be varied instantaneously and from any point, so that it is unnecessary to place the motors close up to the machine or even in the main building; they can be conveniently situated in an annexe, immune from moisture or dust, with an extension shaft passing through the partition wall transmitting the power by a single pair of gears at the machine.

There are many points of interest in the electrical driving of paper mills which cannot be referred to in this paper, but before concluding these notes it seems well to call attention once more to the ease of control and to the very complete arrangements that can be provided for stopping the machine from almost any position, thus ensuring a much greater security of life and limb.

Institution of Municipal and County Engineers.

THE fifty-third annual general meeting and conference of the Institution of Municipal and County Engineers will be held in Bristol from June 23rd to 26th next inclusive. The following programme has been arranged:—

On Wednesday, June 23rd, 1926, the annual general meeting will be held at 10 a.m. It will be restricted to corporate members of the Institution, who should assemble in the Great Hall of the University of Bristol. The outgoing president, Mr. Frank Massie, M. Inst. C.E., will preside. After the transaction of the usual business visitors and delegates will be admitted at 11.30 a.m., and the meeting will be welcomed by the Lord Mayor of Bristol, after which Mr. L. S. McKenzie, M. Inst. C.E., will be installed as president and will deliver his presidential address. The awards of premiums will then be announced and presentation be made of the Scorgie Challenge Shield to the District contributing during the past year the largest amount per member to the Widows' and Orphans' Fund, and of the Carter Challenge Shield to the District contributing during the past year the largest amount to the Widows' and Orphans' Fund. At 12.30 p.m. the party will assemble outside the University Tower and proceed by charabanc by the new low-level road (Portway) to the docks at Avonmouth, passing the Sea Mills housing site (Dorman-Long houses) on the way. Luncheon will be taken at the docks at 1.30 p.m. At 2.30 p.m. a tour of the docks will be begun: (1) General view; (2) dock extension works; (3) granary; (4) cold storage. At 4.30 p.m. the party will proceed by charabanc to Blaise Castle Estate (a recent acquisition of the Corporation), and take tea at Blaise Castle House, by invitation of the Lord Mayor of Bristol. The return to Bristol will be made *vid* Westbury-on-Trym, Stoke Lane, Stoke Hill, Sea Walls, Promenade, Clifton, Park-street. On the Thursday, at 9 a.m., there will be a meeting of subscribers to the Widows' and Orphans' Fund, and at 10 a.m. an address will be delivered by Mr. G. L. Pepler, F.S.I., Town Planning Inspector, Ministry of Health. Papers Nos. A and B will then be discussed. At 2.15 p.m. addresses will be delivered by Sir Henry Maybury, K.C.M.G., C.B., Director-General of Roads, Ministry of Transport, and by Dr. I. G. Gibbon, C.B.E., Assistant Secretary, Ministry of Health. Papers Nos. C and D will then be discussed. The annual dinner of the Institution will be held at the Victoria Rooms at 7.30 p.m.

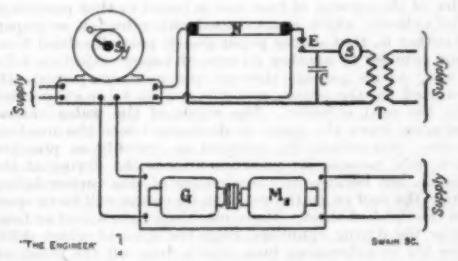
On the Friday, June 25th, 1926, there will be the following alternative visits:—(1) Blagdon reservoir and wells. The party will leave Prince-street at 9.45 a.m. in charabancs for Bristol waterworks, *vid* Bedminster Bridge, Coronation-road, Winterstoke-road, Bedminster Down housing site, Barrow service reservoirs and filter beds, Barrow, Cambridge Batch, Flax Bourton, Chelvey pumping station, Brockley Combe, Langford, Blagdon Combe, Blagdon reservoir, Burrington Station, Burrington Combe, Cheddar Gorge, Cheddar (luncheon), Wells (tea), Farrington Gurney and Clutton, passing through the Knowle housing site. (2) Tytherington stone quarries. Charabancs will leave College Green at 10 a.m. for Tytherington stone quarries, passing through Park-street, Henleaze-road, Kellaway-avenue, Filton housing site (stop thirty minutes), Almondsbury, Ridgeway, Earthcott Green. Luncheon at Tytherington. Then to Bath *vid* Cromhall Charfield, Wickwar, Chipping Sodbury, Acton Turville, Castle Combe, Chippenham, Corsham, Box, Bradford-on-Avon, Freshford and Limpley Stoke. Tea in the Pump Room at Bath, by invitation of the Mayor of Bath. (3) Wills' tobacco factory (Imperial Tobacco Company). Start 10.30 a.m.; and (4) Fry's chocolate works. Start 2 p.m. At 7 for 7.30 p.m. there will be a ladies' festival of the Municipal and County Engineers' Lodge, No. 3920, at the Grand Hotel. Dinner and dance.

On the Saturday morning there will be the following alternative visits:—(1) Speedwell and Fishponds housing sites, leaving College Green by motor coaches at 10 a.m.; (2) Weston-super-Mare abattoirs, leaving Temple Meads Station, Bristol, by train at 9.10 a.m.; (3) Bath sewage works, Saltford, leaving Prince-street at 10 a.m. and proceeding *vid* Keynsham and Jolly Sailor to Saltford sewage works by motor coaches; (4) Bristol Tramways Company's depôt and motor works, leaving Prince-street at 9.45 and proceeding to the tramways and motor works at Brislington by motor coaches; and (5) Knowle and Bedminster Down housing sites, leaving College Green by motor coaches at 9.45 a.m.

The following is a list of the papers which will be presented to the meeting:—(A) "Re-planning of Developed Areas," by W. T. Lancashire, M. Inst. C.E., City Engineer, Leeds; (B) "Duties of a Resident Engineer on a Sewage Scheme," by H. R. Sayer, A.M. Inst. C.E., Engineer's Office, Battersea; (C) "Asphalt," by W. J. Hadfield, M. Inst. C.E., City Surveyor, Sheffield; and (D) "Bristol Housing," by A. H. Claypoole, A.M. Inst. C.E., Divisional Engineer, Bristol, and A. W. Smith, Secretary to the Housing Committee.

The Stroborama.

IN the *Bulletin de la Société d'Encouragement pour l'Industrie Nationale* of last February, which has just been issued, we find an interesting paper by MM. Laurent and Augustin Seguin on a new apparatus for studying mechanism in motion. Stroboscopes may be roughly divided into two main classes, those in which vision is interrupted by some opaque object and those in which vision occurs owing to instantaneous flashes of light. A familiar example of the latter is the employment of an electric spark to illuminate a flying projectile, as in Professor Vernon Boys' experiments. The Stroborama, as the Messrs. Seguin call their instrument, belongs to the second of the two orders we have named, but instead



of employing a spark, the inventors use a tube filled with neon gas, and by an ingenious arrangement they produce such high local illumination that moving parts may be studied in the ordinary light of a room.

The arrangement of their apparatus is shown diagrammatically in the accompanying figure. In this diagram Sy stands for the rotary contactor or its equivalent which constitutes the synchroniser. Its purpose is to discharge a condenser of small capacity, which is charged to some hundreds of volts by the direct-current motor generator M_2G. The tension is raised to a point which is just sufficient to permit the passage of the current in the tube of rarefied gas N, but it is only sufficient by itself to illuminate the tube very slightly, and its real purpose is to act as a "fuse" or relay for a much higher current. This current, or, more properly speaking, charge, is divided by a powerful battery of condensers C, which is continuously charged through a transformer T from any electric supply. The charge in the secondary of T is rectified in the valve S. The lighting tube N is preferably filled with neon, on account of its great luminous properties. It is placed in the discharge circuit of the lighting condensers C through a spark gap E. This spark gap E is so adjusted that no discharge can take place until the relay action already described has been started, but it then takes place with exceeding rapidity illuminating the tube N for an inappreciable fraction of time.

This arrangement permits of unlimited illumination because the lighting current does not pass through the synchroniser, and may therefore be as great as the conditions require. Moreover, since the lighting circuit has very little self-induction, the lighting is practically instantaneous. In fact, when examining a disc turning at a peripheral speed of 100 m. per second, two points no more than 1 mm. apart are sharply distinguished.

One advantage associated with the employment of the neon tube is the red colour of the light which it emits, for on account of this coloration parts illuminated by the tube are easily distinguished even in daylight. In the apparatus as made for industrial use, the neon tubes are arranged in a grid form, covering an area of 1 square foot or more. The apparatus is so placed that the tubes illuminate the part which is to be examined, and by suitable timing of the synchroniser the usual stroboscopic effect is produced.

A NEW FORM OF ELECTRIC-HYDRAULIC STEERING GEAR.

AT a meeting of the Institute of Marine Engineers, held on Tuesday, April 27th, Dr. Hele-Shaw and Mr. T. E. Beacham gave a description of the new form of steering gear which has been made possible by recent improvements in the variable stroke pump and its application to the electric-hydraulic ram system of rudder control. The advantages of the new construction were enumerated by the authors under the following three headings:—(1) A new, and it is believed, greatly improved variable stroke pump; (2) a control valve for obviating the necessity of reversing the pump itself; (3) an automatic valve for preventing injurious shocks from the action of the waves causing any injury to the structure of the ship. The new pump was displayed at the recent Shipping, Engineering and Machinery Exhibition at Olympia, and drawings, together with a description of it, will be found in THE ENGINEER for December 18th last. The authors said one of the chief improvements of the design when it was compared with the original Hele-Shaw pump was that the valve of the new pump was run on roller bearings, so that the thrust was no longer taken on surfaces of the rotary cylindrical valve. The adjacent parts of the valve and its casing could, therefore, be made of cast iron, with a fine clearance, which gave a minimum of leakage or slip. A point of the greatest importance was the fact that when the steering gear was running for a long time in the zero position any danger of heating of the cylindrical valve by abrasion was entirely obviated. Another improvement was the greater silence of the new pump. The cause of the disagreeable hum or buzzing sound in the old form of pump, a noise which might be transmitted throughout the whole of the ship, had now been discovered. It could be said that noise was now entirely done away with owing to the new form of construction adopted.

As to the control valve, a new type of valve had been introduced which did not rotate on its cylindrical axis, but merely had a movement in the direction of its axis. With such a construction a working fit had been obtained, which resulted in an almost complete absence of any leakage. Incidentally, the new control valve did away with the necessity of reversing the pump itself, as it reversed the direction of flow of the working fluid.

A valve had also been fitted to prevent shocks on the rudder from being transmitted to the deck plates. Although the provision of such a valve was not new in itself, the form of valve which had been adopted possessed several novel features. The authors stated, however, that whilst previous valves of that kind were not arranged to operate until the full hard-over pressure had been reached, the new valve acted when the rams, by reason of their reversed motion, caused a pressure in the cylinders of not less than half the maximum pressure.

The paper was illustrated by a working model and by illustrations of control valve and an actual steering gear, which has been constructed for a motor yacht to replace the hand steering gear which is now in operation.

BRITISH STANDARD SIDE SCUTTLES AND FRAMES.

A BRITISH standard specification for ships' side scuttles and frames, Type "A," has recently been published by the British Engineering Standards Association. The specification deals with side scuttles and frames suitable for six different positions on a vessel, i.e., from 14ft. above deepest load water-line down to under water type. There are six tables with plans attached as well as a key to all tables. The side scuttles dealt with in the specification are suitable for passenger vessels and for the better class of cargo boat.

Shipowners, when laying down new tonnage, might consider with advantage specifying side scuttles to the British standard specification, as these fittings are designed to give good service under all conditions, and they should cost less to produce, as the specification has been drawn up in order to minimise the number of different designs and variations in scantlings which now exist for these fittings. The B.E.S.A. has under preparation a specification for side scuttles for cargo boats, Type "B," which should be ready for publication towards the autumn of this year. Copies of the new specification—No. 3024–1926—can be obtained from the B.E.S.A., Publication Department, 28, Victoria-street, London, S.W. 1, price 1s. 2d. post free.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Trade Situation.

IRON and steel masters in the Midlands and Staffordshire are marking time, awaiting the outcome of the efforts for peace in the coalfields, and business in iron and steel is practically at a standstill. There is a little activity here and there, small parcels of material needed for immediate consumption changing hands, but there is no bulk buying, and forward contracts are regarded as altogether too risky, equally from the buyers' and sellers' points of view. At the time of writing, the predominant feeling would appear to be one of pessimism, and the Midland market is prepared for the worst. It is not inferred that the differences will necessarily culminate in an open rupture. In the iron trade, however, a bad compromise, which would leave the crux of the dispute for future determination, would be regarded as worse than no settlement. Everyone, naturally, hopes for the best.

Steel.

Orders for steel continue to come in regularly, though only for small tonnages, called for for immediate requirements. Still, the aggregate is encouraging. Midland steel works maintain a fair degree of activity, and there seems no reason why the output for the month should not maintain the high rate registered in March. Good business continues to come from the railways, and an additional outlet for steel plates is likely to be found in the building of all-steel railway coaches. There is thought to be every probability that the experimental construction now authorised by important home and foreign railways will ultimately lead to their adoption. Engineers' demands are small at the moment, new projects being held up pending a settlement of labour difficulties. No market effect has resulted from the efforts to re-stabilise steel sections, joists and ship, bridge and tank plates at a higher level. The advance of half a crown was too small to affect materially the placing of orders. With the ruling price of ship plates at £7 17s. 6d., the engineer on the North-East Coast has an advantage of 5s. in the price he pays for plates as against the Midland engineer. Reduced quotations from the Continent have been received this week, and, as the franc value is still declining, it is unlikely that the bottom has been reached. Some small orders are being given out for continental steel, but the threat of industrial paralysis makes buyers move warily. Steel joists can be obtained here at a little over £6, against the Midland price of £7 2s. 6d. Finished bars are offered, delivered in the Black Country, at £6 4s., which is substantially below local makers' prices. Large quantities of such material are no doubt being shipped from Antwerp direct to foreign destinations to the instructions of Birmingham merchants. The price advance has been applied to semi-finished material, billets having increased to £6 2s. 6d. Foreign billets, on the other hand, are rather weaker at £5 3s., and are being bought in large quantities. Foreign sheet and tin bars at £5 9s. to £5 10s. are being increasingly used in the galvanised sheet and tin-plate trades. Steel scrap is slightly weaker at £3 7s. 6d., delivered South Wales.

Raw Iron.

Midland pig iron prices are firm and unchanged, though it is stated that one or two Derbyshire houses that have been endeavouring to keep foundry qualities up to the £3 7s. 6d. level have now modified their attitude. They were getting very little, if any, business, competitors securing the few orders that came on to the market, being content to accept £3 6s. to £3 6s. 6d. Raw iron buying is restricted to small lots, though there has been some speeding up of delivery by consumers anxious to secure supplies against the possibility of a coal stoppage. Forward contracting is almost non-existent. On 'Change to-day Northamptonshire makers quoted forge at £2 15s. to £2 16s., and No. 3 foundry £3 3s. 6d. For Derbyshire forge £3 was the ruling figure, while foundry ranged from £3 6s. to £3 7s. The output of furnaces is for the most part being absorbed, but a little stocking of material is reported. North-East Coast hematite is being bought cautiously at about £3 15s. per ton at furnaces. Blast-furnace coke sells steadily, grades such as are used in blast-furnaces of the Midlands being sold at 14s. to 14s. 6d. a ton at ovens.

Finished Iron.

The Staffordshire finished iron trade shows a slight improvement, some ironworks this week reporting that they are busier. Railway buying is benefiting this department in several ways, and a few engineering firms are calling for a fair aggregate of best quality iron. Marked bars remain firm at £14, but in the merchant and common bars section, prices are being weakened a little, as the result of the Lancashire reduction to £11 for Crown bars. The iron trade contrasts somewhat significantly with the steel department in the absence of price understanding between Staffordshire, Lancashire and South Yorkshire, the relative quotations of which differ considerably. The Staffordshire makers want £11 2s. 6d. for Crown bars and £10 5s. for nut and bolt and fencing bars. Wrought iron gas tube strip ranges in value from £12 5s. to £12 10s. Demand is not so brisk as it was, though the works are still making full time.

Galvanised Sheets.

While the output of galvanised sheets is fully maintained some slight falling off in new business is accountable for a little price weakness, quotations now ranging between £15 5s. and £15 10s. Buying is practically continuous for a world-wide market, and galvanised sheets have the distinction of securing the largest individual export for March, namely, 78,118 tons, against 65,351 tons a year ago. For the three months the increase was about 28,000 tons. Tin-plates shipments were somewhat heavier, but there is still a large amount of unemployed plant.

Encouraging.

Midland industrialists are encouraged by the decided rise in exports of iron and steel, as shown by the Board of Trade returns. Bars, plates, wrought tubes, railway rails, galvanised sheets and tin-plate all show increases. The unfortunate part of the return is that it shows a very heavy total of imported steel, continental competition having been decidedly keen. Our exports of iron and steel and manufactures thereof, it is noted, increased in tonnage from 336,664 in January to 339,474 in February, and 406,547 in March, a total for the quarter of 1,082,685 tons. This shows a considerable expansion on the 936,238 tons exported in the corresponding period of last year, and is an improvement on the 1,031,846 tons exported in the December quarter of 1925. It is contended by iron and steel masters hereabouts that such progress could not have been achieved if the iron and steel industry had not done its share in adjusting selling prices to meet the lower production costs of continental rivals. It is unfortunate that in order to secure such returns we have had to avail ourselves of increased quantities of raw iron and steel imported from Belgium, France, Germany and other producing countries at prices with which our own furnacemen could not possibly compete. While our exports of iron and steel last quarter amounted to over a million tons, imports totalled 708,727 tons, having risen from 221,663 tons in January to 228,538 in February and 258,526 tons in March. However, the trade statistics are considered not only to be encouraging, but to indicate definitely that there is a real prospect of business expansion, given peace in the labour world and a mutual determination by both master and man to use every effort to foster and encourage it.

Railway Work for the Midlands.

Amongst the contracts recently placed by the Great Western Railway Company is one for the supply of eighteen motor omnibus chassis to the Maudslay Motor Company, Ltd., Coventry, and one for the supply of two 30-cwt. electric luggage lifts at Queen-street Station, Cardiff, and an 8-cwt. electric lift at the general offices, Paddington, to Smith, Major and Stevens, Ltd., Northampton.

Steel Frame Houses.

That the Coventry Housing Committee is in favour of the erection of steel frame houses is shown by the fact that it is recommending the City Council, subject to the confirmation of the Ministry of Health, to erect 250 parlour-type houses on the "Wild" steel frame system, at a cost of £126,250, being at the rate of £505 per house. Application is to be made to the Ministry for sanction to a loan in respect of the houses.

Midland Miners' Decision.

Midland miners have decided practically unanimously to support their leaders. At a meeting on Sunday, under the auspices of the Warwickshire Miners' Association, approval was unanimously given to the action of the executive of the Miners' Federation in resisting any extension of hours, reduction of wages and district agreements. Cannock Chase miners have decided to ignore an offer of the owners—in the absence of any agreement between the owners' and workmen's representatives being made in the meantime—to continue work at the pits during the month of May at the same rate of wages as now prevails, namely, 46·57 per cent. on the basis rate now in force, with the subsistence wage and allowances as at present, and to cease work if no national agreement can be made.

To Share Profits.

Interest is occasioned in Midland industrial circles by the announcement by Sir Harold Bowden, chief proprietor of the Raleigh Cycle Works at Nottingham, which employs 2500 workers, that the management had decided to allocate for division between the employees each year a share in the profits of the business. It is stated that the firm's employees will benefit materially under the scheme, details of which Sir Harold gave at a meeting of workers on Saturday last.

Unemployment.

There is a decrease of 5952 in the number unemployed in the Midlands and a decrease of 4602 in the number on short time or out of work temporarily. These figures show a big improvement on the totals recorded in the last two weeks, when there was a depression, partly due to the Easter holiday period. Cradley Heath, where there had been a big slump, shows a decrease, the total of 3193 comparing with 4172 given in the last return.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

General Conditions.

GENERALLY speaking, the state of the engineering industries in Lancashire does not make for a large volume of buying in the iron and steel markets. Textile machinists are far from busy so far as the home market is concerned, apart from the demand for finishing machinery, and the export markets are very inactive. The brightest spots are probably the electrical engineering establishments, and, to some extent, the locomotive works. Most other branches are very indifferently employed. The "stay-in" strike at the carriage and wagon works at Newton Heath of the London, Midland and Scottish Railway Company, which started on Friday of last week, has resulted in a lock-out of 3000 men, which operated from Wednesday morning, April 28th. The latest development in the engineering dispute in the Lancashire district has been the rejection by Blackburn employers of the demand for an increase of £1 a week, and the application, along with those of the employees in the Manchester and other areas, has been referred to the Central Conference at York. Trade in iron and steel in Lancashire continues to be dominated by the uncertainties in the coal-mining industry, and pronounced inactivity in the markets, which is certainly not due entirely to the state of the consuming industries, continues to be reported.

Non-ferrous Metals.

The fluctuations in the non-ferrous metals have been less violent during the past week than they had been recently, but the position is still far from approaching anything like stability. In the case of tin, the demand from consumers is not good, and if supplies of the metal were normal values would have been affected much more severely than they have been. As it is, some ground has been lost on balance, although at the moment the tendency seems to be steadier. The demand for copper locally is slow in most branches. The American consumption is said to be improving a little, and there is a rather better feeling in some of the continental markets. Prices are moderately steady now, although they are a shade lower on the week. Supplies of spelter are in excess of current demands, and values can hardly be described as steady, although movements have not been serious. Lead has lost some ground on the week, as supplies have been more than sufficient to meet the restricted demand, but at the time of writing the tendency seems to be rather firmer again.

Iron.

The iron market this week appears to have been increasingly affected by the general industrial outlook, and buying has been on a small scale, although towards the end of last week several makers reported a fair volume of small orders from users who were anxious to safeguard themselves against a stoppage. It cannot be said, however, that altogether these orders amounted to very much, and, in any case, they seem now to have tapered off. As a matter of fact—and this applies to both iron and steel—manufacturers are no more anxious to commit themselves than are buyers, more especially as regards forward business, the net result being that the turnover is very moderate indeed. From some centres one hears of weaker prices for pig iron, but so far as the Manchester market is concerned, there has been little appreciable difference since last week, Derbyshire No. 3 foundry pig being quoted at about 75s. per ton, delivered into this district; Staffordshire and Lincolnshire at about 76s.; West Coast hematite at 74s.; and Scottish No. 3 pig iron, at about the same figure. East Coast hematite is quoted here at about 76s. per ton at furnaces. Lancashire bar iron is quiet but steady at the lower values of £11 per ton, delivered Manchester or equal distance for Crown bars, and £9 15s. for seconds.

Steel.

So far as the steel market is concerned the demand has been very moderate, and there is no apparent likelihood of improvement until the outlook is clearer than it is at the moment. Constructional engineers in this area are far from active, although there are one or two important schemes that are expected to mature in the near future, always provided, of course, that nothing untoward intervenes. In the meantime, however, there are very few steel makers offering on this market who are able to report a satisfactory volume of business. Inquiry is poor, and what business has been done has been for very small parcels. A notable feature of the market since minimum prices were established recently is the entire absence of complaints of undercutting. Plates are firm at £7 17s. 6d., joists and sections at £7 2s. 6d., and steel bars at £8 to £8 5s., although in the last mentioned case one does hear still of £7 17s. 6d. as a possible basis. There has been some inquiry during the week for galvanised sheets for India, but it has not been substantial. There is a better tone, however, as regards values, which are now at £15 7s. 6d. to £15 12s. 6d. per ton f.o.b., compared with as low as £15 2s. 6d., which was the basis of actual business quite recently. Some demand for thin gauge black sheets for Japan has been reported. Sellers of continental steel have not booked much since last report, and quotations continue to be shaded. Sheet bars are at about £5 2s. 6d. per ton delivered Manchester, for net cash against shipping documents, joists at £5 12s. 6d., steel bars at £6 to £6 2s. 6d., Siemens' plates at £6 10s., and ordinary plates at about £6 6s.

Scrap.

The demand continues very poor both for non-ferrous and iron and steel scrap, and while values are not appreciably changed, the tendency is easy. Scrap lead is on offer at about £28 per ton for sorted and graded qualities, delivered to consumers' works, zinc at £24 10s., clean light copper at £58, best selected gun-metal at £53, and heavy yellow brass at £46. Mild steel scrap continues weak at £2 12s. 6d. per ton; textile machinery scrap is quoted at about £3 10s., ordinary machinery cast iron scrap at £3 5s., and wrought iron at about the same figure, free on truck Manchester, in all cases.

Visit of a London Company to Newton Heath.

The Master, Wardens, Court of Assistants, and Livery of the Worshipful Company of Tin-plate Workers, *alias* Wireworkers of London, paid a visit on April 22nd to the Moston Works of Rd. Johnson, Clapham and Morris, Ltd. They went through the works and saw various processes carried out in the manufacture of copper wire, and all classes of steel and other wirework being manufactured, including wire netting and the weaving of wire. At the conclusion of the visit the party was entertained by Mr. A. L. Johnson—chairman and managing director of Rd. Johnson, Clapham and Morris, Ltd.—and Mrs. Johnson, and by Mr. O. E. Wilson, a director of the firm and general manager of the works, assisted by Mr. B. Taylor, director and manager of the parent company's subsidiary, Johnson's Reinforced Concrete Engineering Company. During

the speeches Mr. C. W. Berry, Master of the Worshipful Company, made an announcement that it would have pleasure in presenting a silver cup to be competed for by department teams of the firm's employees at cricket, to be called "The Worshipful Company of Wireworkers Cup."

The British Cotton Industry.

In proposing the adoption of the annual report of the Manchester Association of Importers and Exporters on Thursday, 22nd inst., Mr. Harold A. Baerlein, the chairman of the Association, referring to the past year's trade, said it was really a matter for surprise, not that British trade had been poor, but that it had been as good as it was. Speaking of the cotton industry, he said that in the past the capital and the technical management of industry were in the same hands, and it was to be regretted that in recent years there had been a tendency to divide them. In too many instances management had passed into the hands of the financiers, who were more concerned with the artificial manipulation of share values than with their products, and the technical management was left in the hands of paid servants, who, whatever their own views might be, had to follow the instructions of those who provided the capital. As regards the labour problem in industry, Mr. Baerlein remarked that it had been said that British workmen showed more initiative in America than the American workmen. If there were greater assurance amongst our workpeople that their efforts to increase output would mean not less but more wages, there was little doubt that they would free themselves from artificial restrictions, and the economic position of this country would be greatly enhanced.

BARROW-IN-FURNESS.

Hematite.

In the North-West district there is a tendency to overmake to a not very marked extent at the present, that tendency being due to the quietness which pervades the market, and which is no doubt caused by the uncertainty of the coal trouble. Customers are buying in smaller quantites and asking for immediate delivery, thus dealing in a hand-to-mouth fashion until there is a clearer outlook. There is a possibility of more trade with America in semi-special qualities of pig iron, and there are driblets going to the Continent. A cargo left for Antwerp last week. If it were not for the steel departments taking a fair proportion of the output of iron, there would be beyond doubt a restriction in the shape of damping down for a few furnaces. Makers are holding on to the present output in the hopes that, labour difficulties being overcome, there will be an improvement in the demand and also a renewal of orders for forward deliveries.

Iron Ore.

The iron ore trade remains about the same as it was last week, and its condition will be unaltered until the local iron trade improves, for, generally speaking, the iron ore mines have to rely on local activity, for little goes out of the district. If the iron trade in Scotland and the East Coast improved, there might be a better trade outside. Foreign ore is being brought in restricted quantities from Spain, Algiers and Norway.

Steel.

There is no alteration in the state of the steel trade, which keeps moderately employed on rails, &c., the rails now mostly being for abroad. At Workington there are not sufficient orders to keep the rail mill fully employed during the month, but Barrow is running regularly. The hoop and small section mills are better situated.

SHEFFIELD.

(From our own Correspondent.)

Larger Output of Heavy Steel.

WITH the outlook clouded by the threat of labour troubles, there is no change to report in the trade situation, but the facts suggest that, if industrial peace could be established, there would be a tendency to improvement. For some time, the open-hearth furnaces have been working better than they did last year, and the improvement in output continues. At the same time, there is no forward buying. Users of iron and steel are regulating their purchases so as to have as little stock of material on hand as possible, in case they should have to close their works in consequence of a coal stoppage. Transactions in raw material are on a similarly hand-to-mouth scale. The *Journal* of the Sheffield Chamber of Commerce states that the shipbuilders are obtaining rather more orders than have been in evidence for a long time, and it looks for a steady revival, though nothing very great for awhile. Railway orders continue one of the best local lines on the heavy side, and include a wide variety of supplies from first-class coaches to fish plates and bolts. Axles, springs, tires and various castings and shapes for rolling stock are all in request, the high quality of our goods telling against the cheaper products of some of our rivals.

Other Steel Branches.

The recent serious decline of activity at the cotton mills has affected local firms supplying steel to the textile trades, and they are now doing badly. A falling off is reported in orders for rolling and forging work, crucible steel and tools, probably owing in the main to the uncertain industrial outlook. "Wire rods," again reports the Chamber of Commerce *Journal*, "bright-drawn steel, special steel plates, miscellaneous castings for engineers and house builders, tubes and pipes and their fittings, stove grates, motor car and cycle frames, are all good lines so far as volume of orders is concerned, but profits, unfortunately, are small. Local makers of picks, shovels and general navvying and quarrying tools are much more actively employed than for some months past. There are also good orders for small steel balls and various washing and dredging parts for gold-mining enterprises in South Africa and elsewhere."

Cutlery and Plate.

Although some improvement is reported on the week in the number of orders booked for cutlery, spoons and forks, the condition of these trades is still very bad. Not only does acute depression exist, taking the trades as a whole, but, owing to the severe cutting of selling prices, many of the transactions entered into are of an unremunerative character. A good many businesses are said to be financially in a very delicate state. The demand for silver and plated hollow-ware is on a very restricted scale. The Admiralty and War Office are now placing, or considering the placing of, their annual contracts for steel, tools and hardware. The quantities required by the Admiralty are much smaller than before the war, and they will no doubt suffer further reductions as the closing of the dockyards proceeds. Among the items required on naval account this year are 4000 stainless table and cheese knives with plated handles, while the requirements of the War Office include about 8000 table knives and carvers.

Use of Smokeless Fuel.

An interesting application of smokeless fuel for domestic heating purposes is being tried at Rotherham. John Brown and Co., Ltd., at their offices in that town, are burning blast-furnace coke in an open fire-grate of apparently ordinary type, with highly satisfactory results. The fireplace has no underdraught, but a series of perpendicular flutings or channels at the back carry the necessary air required to aid the combustion.

The Use of Coal Conveyors.

A few weeks ago the Midland Institute of Mining Engineers appointed a special committee to make a full investigation into the question of the underground conveying and loading of coal by mechanical means, with a view to bringing about an improvement in the output per man employed in the pits. Evidence of the value of these appliances was placed before the Institute last week by Mr. B. H. Pickering, who read a paper on "Coal Conveying as Applied to the Barnsley Bed of South Yorkshire," in which he set out the results of tests and experiments made during the past twelve or fourteen months at a colliery in the Doncaster district. Mr. Pickering said that he believed that in no previous instance had the experiment of conveying in the Barnsley seam in the Doncaster area been tried. A shaker type of conveyor, delivering to a gate-end loader in the loading road, was installed at the face. The plant was driven by compressed air, and had an estimated capacity of 50 tons per hour to the loading point. It was first installed on an "end" face, and it met with marked hostility on the part of the men, but that feeling was gradually broken down, and in a few months the men were all converted and had no desire to return to the "tubbing" system. The advantages following from the use of the conveyors were shown by the following increased percentages:—Tons per man per shift, 36·75; average wage, 33·5; more rapid face advancement, 33. In a hand-got face the results were not so good, and Mr. Pickering attributed that chiefly to prejudice on the part of the workmen. He was strongly of opinion that the machines could be applied in a seam such as the Barnsley seam in South Yorkshire equally as successfully as in those parts of the South Wales and Scottish coalfields where they are now in use.

Hadfields and a Motor Firm.

For the past few years Hadfields, Ltd., of Sheffield, have had an arrangement with the well-known motor car firm of A. Harper, Sons and Bean, and their interests in that direction have now been readjusted in a favourable manner. Early in 1926 the Sheffield company secured the control of the affairs of A. Harper, Sons and Bean, and it now holds approximately three-quarters of the debentures, preference shares and ordinary shares. The directors of Hadfields, in their report, state that "this interest has been acquired on such terms as to justify your directors in looking forward with confidence to a satisfactory return in the future." Hadfields' profit for 1925 was £117,660, as compared with £80,662 in the previous year, and the ordinary dividend has been increased from 2½ to 3 per cent., less tax.

Local Contracts.

The Great Western Railway Company announces that ship repair contracts have been given to the Sheffield firms of Cammell Laird and Co., Ltd., and John Brown and Co., Ltd. A Berlin correspondent states that Germany, which up to a short time ago was the chief supplier for the Russian electric industry, has been completely outdistanced by the English industry. He mentions that orders for the big Russian power stations at Schatutaare have been placed mainly with Vickers in London.

Chesterfield Progress.

At the opening of an electric service department by Chesterfield Corporation last week, some interesting details were given as to the progress made by the electricity undertaking of the borough. It was stated that during the past year the sale of current had increased by 1,181,000 units. Lighting had increased by 22 per cent., power by 18 per cent., and cooking and heating by the remarkable figure of 82 per cent. The increase in consumers in three years was 225 per cent. The price of current for lighting had been reduced by ½d. to 4d. per unit, and meter rents for cooking and heating were to be abolished. These reductions represented £2200. A sum of £2400 had been allocated towards relief of the rates. But for that allocation, a full penny per unit would have been knocked off the price of current for lighting, and the charge to power consumers would probably have been reduced. Another matter of interest at Chesterfield is the adoption of up-to-date methods of refuse collection and disposal. A Ministry of Health inquiry was held last week into the application of the Corporation to borrow £7000 for the provision of refuse disposal plant at Stonegravels. The Town Clerk said that it was estimated that, when the full scheme of reorganisation had been completed, the cost of refuse disposal would be reduced from £4170 to £3000 per annum, which was equal to the saving of a penny rate.

New Pit-head Baths.

An installation of pithead baths was opened last Saturday at Tinsley Park Colliery, Sheffield. There are 100 cubicles in an up-to-date building lined with white glazed tiles. The baths have cost about £10,000, towards which £8000 has been contributed by the Miners' Welfare Fund. The proprietors of the colliery have erected, in front of the building, a clock in memory of the eighty-nine men from the colliery who gave their lives in the Great War.

NORTH OF ENGLAND.

(From our own Correspondent.)

Trade Paralysed.

BUSINESS in all industrial sections in the North of England has been completely held up this week by the crisis in the coal trade. The position is one of great difficulty, and the outcome of the negotiations between the coal owners and the miners' representatives is awaited with grave concern. A stoppage of the pits would certainly lead to a great industrial disaster. The huge coal and coke-consuming industries in this district would speedily absorb their stocks of fuel and have to close down within a very short time of the discontinuance of fuel deliveries. The position in the Northumberland and Durham coal trade is different to that in many other coal-producing areas, inasmuch as a very large percentage of the coal won is for the export trade, and it is not easy to see how many of the collieries can carry on without help in some form or another. This month wages in Northumberland would have been 35·42 per cent. on the basis, and in Durham 35·76 per cent. In the former county the minimum percentage is 100 and in Durham 110 per cent., and the Government's subvention makes up the difference. In their new terms, the owners offer 50 per cent. on the basis in Northumberland, and 53·49 per cent. in Durham, and this they have declared is the utmost the industry can stand. It is contended that even on these figures half the collieries in each county would make a loss.

Cleveland Iron Trade.

The Cleveland pig iron market is in a state of almost complete stagnation owing to the coal crisis, buyers and sellers alike being content to await developments. In spite of the fact that so little new business has been booked this month, output and deliveries have been well maintained in consequence of the existence of heavy running contracts, and the Cleveland makers are in the happy position of being unencumbered with heavy stocks. No doubt if a coal settlement is reached producers will promptly need to fill their order books, as contracts are now rapidly petering out, but just now they are as reluctant as consumers to operate. They fear a rise in fuel prices, which will send up the cost of production, and prefer to see where they stand in that respect before they sell very largely ahead. Still there is plenty of prompt iron on offer at the recognised market rates, which to home consumers are as follows:—No. 1 Cleveland foundry iron, 73s. 6d.; No. 3 G.M.B., 70s.; No. 4 foundry, 69s.; and No. 4 forge, 68s. 6d. An addition of 6d. per ton is made to the foregoing prices in the case of export orders.

Hematite Pig Iron.

Extreme quietness continues to characterise the East Coast hematite pig iron trade, but makers have tired of cutting prices and are keeping the nominal quotations for mixed numbers unchanged at 76s., and No. 1 at 76s. 6d., these being uniform prices for both home and export. It is still the case, however, that concessions can be obtained for orders of any magnitude.

Ironmaking Materials.

Very little business is passing in the foreign ore trade, but deliveries under running contracts continue on a heavy scale. Best Rubio ore is unaltered at about 21s. 3d. per ton c.i.f. Tees. Owing to the uncertain outlook in the fuel trade, sellers have been less inclined to sell coke at recent prices. On the other hand, buyers seem apathetic, and probably good medium furnace kinds are no more than 18s. 6d. per ton delivered at the works though some sellers ask 19s.

Manufactured Iron and Steel.

In the steel trade there has been some pressure for deliveries of constructional material, but apart from this the demand has fallen away almost to nothing, the coal crisis here again exercising a paralysing effect. Prices are unaltered.

The Coal Trade.

There has been no movement whatever in the Northern coal trade, owing to the uncertainty caused by the protracted deliberations in London. Both buyers and sellers have been unable to operate, and it is impossible to quote prices for May. In the meantime both Northumberland and Durham have suffered from the fact that buyers are disinclined, in view of the uncertain outlook, to place business, and orders, as a consequence, are being sent out of the country. Supplies usually provided by Northumberland and Durham are going to Westphalia and Silesia, whilst the United States have taken some orders. An order for 50,000 tons of best steam coals has been secured by Silesia tenderers at 17s. per ton c.i.f. shipment, to be made from Danzig in May and June. The offers for best Northumberland steams are said to have been round about 19s. 3d. per ton. This is an illustration of the keen competition by Silesia in foreign markets. It is gratifying to note, however, that the order for the French State Rail-

ways for 100,000 tons of large and small steams has been secured by Tyneside merchants at a price, it is understood, of 20s. per ton c.i.f. delivery over the rest of the year. Market values are nominally unaltered, but some cargoes have been offered in second hands at slight discounts without, however, leading to business, as there has been great difficulty in the matter of loading turns owing to collieries being fully stemmed for April. In the Northumberland steam coal section sellers are not quoting for May pending the deliberations in London, and buyers are only inquiring for small lots, chiefly for the coasting trade. Best Blyth steams are nominally 16s., with Tyne primes and similar grades at a like figure, and second qualities at 15s. 6d. Stocks of small steams are fairly good, and values are unaltered. Best descriptions are at 8s. 6d., and second sorts at 8s. The export demand for coke is at a low ebb, and home requirements are small. There are large stocks and prices are easy at 18s. to 19s. for gas makes, 17s. to 20s. for patent foundry, and 26s. to 30s. for beehive coke.

SCOTLAND.

(From our own Correspondent.)

New Orders.

It has been reported that an order for forty side-tank locomotives has been received by the North British Locomotive Company, Ltd., Springburn, Glasgow, on behalf of the Egyptian State Railways. This report is very gratifying in view of the considerable amount of unemployment in the district. The works in Springburn have been on short time for some weeks, and a large number of men had been suspended for an indefinite period. The British Tanker Company, Ltd., recently placed orders for six oil-carrying vessels of 10,000 tons deadweight and one of 6100 tons. Of the larger vessels, two will be built on the Clyde, one at Clydebank by John Brown and Co., Ltd., and the other at Port Glasgow by Lithgows, Ltd. The former will be fitted with twin-screw Sulzer engines and the latter with Burmeister and Wain Diesel engines, supplied by John G. Kincaid and Co., Greenock. The Caledon Shipbuilding and Engineering Company, Ltd., Dundee, has received an order to build a steamer of 3000 tons for the passenger and fruit-carrying trade between Liverpool and the Canary Islands, on behalf of the Yeoward Line, Ltd., Liverpool.

Steel.

In most branches of the steel trade business is featureless. Makers are hopeful that the fixing of prices at a steadier level will prove beneficial when industrial conditions are more settled. Inquiries are perhaps a shade more numerous, but business on the whole is quiet at present. Specifications for plates and sections could be dealt with in greater volume, many of the works being at present occupied considerably below capacity.

Steel Sheets.

The demand for steel sheets is somewhat irregular and the flow of orders is weaker for ordinary light varieties for export. Some firms specialising in the production of the lighter gauges for home and export delivery are very busy, both in black and galvanised descriptions. On the whole, prices, though firm, are inclined to weaken somewhat.

Iron.

Reports from the ironworks hold practically nothing of fresh interest. Competition is extremely keen in both iron and re-rolled steel products, and business is still rather disappointing. The capacity of the mills is not in anywise taxed, and while prices are nominally unchanged, a good order could in all probability be more advantageously placed. Pig iron likewise is a very slow market. Demands are of a small day-to-day description, and as a rule could be easily met from stock.

Coal.

The coal market is dominated by the uncertainty as to the final outcome of the present conference between owners and miners. Business on export account is small, buyers evidently placing their orders in other markets where cheaper prices are obtainable, notably Germany and Poland. Some descriptions of Scottish coal have been increased in price, owing to heavier home demands, but most fuels are comparatively easy. Lanarkshire ells and washed materials and Lothians steams are comparatively well placed. Splints have weakened through the decline in South American and Italian demands. Aggregate shipments amounted to 269,571 tons, against 265,485 tons in the preceding week and 205,428 tons in the same week last year.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Outlook.

At the time of writing all the indications point to an eleventh hour settlement if an agreement is to be come to at all between the coalowners and the miners. During the past week hopes of a settlement being reached have rather weakened, and with the end of the month approaching, those engaged on the commercial side of the industry have had to resign themselves to waiting patiently for developments with practically no business to negotiate. Operations have, to all intents and purposes, come to a standstill, as the inquiry for next month's shipment is very restricted, and energies have been directed in the main to getting away steamers which are now in dock waiting to load. At the beginning of this week about twenty steamers were waiting their turn to get into berth, and, of course, shipowners and exporters are very anxious about sailing their boats by the end of the month. The coal market itself is little more than nominal, although there is no doubt that assuming there is no stoppage of work in the coalfield, most coalowners would accept prices showing a reduction of 2s. 6d. to 3s. per ton, as compared with the figures at the moment prevailing. The uncertainty is having a very prejudicial effect upon business. Tenders went in last week for the requirements of the Egyptian State Railways, viz., 150,000 metric tons of large steam qualities. They had to be in at Cairo on the 21st inst., and from the information which has come to hand, the lowest price was about 31s. 5d., submitted by Watts, Watts and Co., while Evans and Reid offered 50,000 tons at 31s. 7d. net c.i.f. Alexandria, and other tenders were fairly close. The tenders had to hold good for ten days, but the news has now been received that the adjudication has been cancelled, from which it is assumed that the railway authorities have decided not to purchase. Whether this decision is due to the prices being considered relatively high, or to the fact that owing to the troubles between the coalowners and the miners delivery cannot be guaranteed is not known. It may be that both may be responsible. In any event, if the business goes elsewhere it will be a considerable loss to this market. Other inquiries on the market are 10,000 tons for Constantinople, and 20,000 tons of Admiralty large coals for delivery May and June to the Norte Railways of Spain. Apart from these inquiries the foreign demand is negligible, and it is evident that a great improvement will have to be seen very quickly, otherwise more than half the collieries in this district will be idle for the best part of next month.

Coalowners' Terms.

Towards the end of last week the South Wales coalowners issued their terms and conditions under which employment is offered to the workmen as from May 1st. Substantial reductions are entailed, but the owners offer alternative sets of proposals, one being for the present seven-hour day and the other for a working day of eight hours. In this coalfield the men are paid the 1915 standard rates plus a guaranteed minimum percentage of 42·22. The owners offer the standard rates plus 5 per cent. as the minimum for the existing hours of working or the present standard rates plus 30 per cent. as the minimum in the case of an eight-hour day. This, in effect, means that the present minimum wage of a collier for a full week would be reduced from £2 18s. 7d. to £2 3s. for a seven-hour day and to £2 14s. per week for an eight-hour day. In the case of day wagemen they also suffer reductions with a graduated scale for married and single men. Most of the day wage men receive at present a subsistence wage of 8s. 0½d. a day, or £2 8s. 4d. for a full week. In place of this they are offered a wage with subsistence allowance varying from 6s. 8d. to 7s. 2d. per day, according to grade, in the case of married men and from 5s. 9d. to 6s. in the case of single men. The coalowners have also reduced from 14·2 per cent. to 5 per cent. the additional percentage on gross earnings granted to piece workers in 1919 as compensation for loss of output owing to the reduction of hours of work from eight to seven. The bonus turn to afternoon and night men is to be abolished, and men are to be paid for actual shifts worked only. The double shift is to be worked when and where required by the owners, while the supply of house coal to workmen is continued as heretofore. Of course, in some quarters the owners' terms are strongly resented, and resolutions have been passed opposing them.

Colliery Officials.

The Executive Council of the South Wales and Monmouthshire Colliery Officials' Union has instructed its branches that, in view of the fact that notices have not been tendered to the officials and consequently no alteration takes place in their terms and conditions of employment, all members are requested to remain at work should a stoppage of work take place in the mines at the end of the week.

Steelworkers' Wages.

Owing to the recent fall recorded in the ascertainment of steel bar prices for the quarter, the Iron and Steel Trades Confederation, acting on behalf of the Siemens steel workers in West Wales, has made formal application for the continuance of the *ex gratia* allowance now made by the employers which would otherwise have terminated at the end of April.

The Llanelly Strike.

The strike of locomotive men at the South Wales Steelworks, Llanelly, continues, with the result that about 1200 steel and tin-plate workmen in the employ of Richard Thomas and Company are still idle. The divisional subcommittee of the Iron and Steel Trades Confederation at Swansea, last Saturday, considered the dispute and decided to take up officially the matter with the employers. Hopes are, therefore, entertained that a settlement will be effected; but, in any event, it is feared that there would be a poor chance of an immediate resumption of work at the steel works owing to the generally unsettled state of affairs in the coal industry.

Current Business.

Operations in steam and anthracite coals have been at a very low ebb during the past week. A certain amount of business has been done in odd parcels for quick shipment, in order to complete cargoes, for which current prices have been paid, but beyond this activity, business has been at a standstill. Present values are not being paid for supplies for loading next month, as it is realised that the market is sure to fall back considerably. The conditions are altogether very unsettled, and even if a stoppage of work is averted, it will be some time before stable conditions prevail, and it is to be feared that collieries will experience a shortage of orders.

CONTRACTS.

The Woodall-Duckham Vertical Retort and Oven Construction Company (1920), Ltd., has received from the South Australian Gas Company an order for the installation of Woodall-Duckham vertical retorts in the city of Adelaide. The plant is to be capable of carbonising 160 tons of coal per day, and Gibbons (Australasia), Ltd., the licencees for the Woodall-Duckham Companies, will erect it.

The Westinghouse Brake and Saxby Signal Company announces that its representatives and licencees, McKenzie and Holland (Australia) Pty., Ltd., of Melbourne and Brisbane, have received an order from the New South Wales Government Railways for a further quantity of 500 resonated impedance bonds, style "J," making a total of 1200 of these bonds ordered by the N.S.W.G. Railways within the past ten months. Like the previous 700, the 500 new bonds will be manufactured within the Commonwealth.

The Italian Brown-Boveri Organisation has secured the contract for the electrical equipments for portions of the suburban system of the Ferrovia Nord between Milan and Saranno and between Bovisa and Meda. At present the work to be carried out consists of :—(1) Equipment for the sub-station at Novate consisting of three 2000-kilowatt power rectifier plants operating at a direct-current pressure of 3000 volts, the step-down being from three-phase 22,000 volts at 42 periods; (2) equipment of eight four-axle motor coaches, each provided with four 184 horse-power—one hour rating—motors, operating two in series across 3000 volts; (3) equipment of eight trailer coaches, provided with drivers' cabs.

The Great Western Railway Company announces that the following contracts have been placed :—(*a*) Supply of fifty chassis for 4-ton goods lorries, John I. Thornycroft and Co., Ltd., Smith-square, S.W. 1; (*b*) supply of eighteen motor omnibus chassis—the Maudslay Motor Company, Ltd., Parkside, Coventry; (*c*) supply of a "Sentino" patented locomotive—the Sentinel Wagon Works, Ltd., Caxton-street, Westminster, S.W. 1; (*d*) repairs to the ss. Reindeer—Cammell, Laird and Co., Ltd., Birkenhead; (*e*) overhaul of ss. St. Helier and St. Julien—John Brown and Co., Ltd., Clydebank; (*f*) overhaul of ss. St. Andrew—Messrs. David Rollo and Sons, Liverpool; (*g*) overhaul of ss. Sir Francis Drake—the Bickle Engineering Company, Plymouth; (*h*) steam heating of locomotive shops at Caerphilly and of new offices at Swindon—Colley, Meikle and Co., Ltd., 15, Great James street, W.C. 1; (*i*) supply of two 30-cwt. electric luggage lifts at Queen-street Station, Cardiff, and an 8-cwt. electric lift at the west end of the general offices at Paddington—Smith, Major and Stevens, Ltd., Abbey Works, Northampton; (*j*) construction of a bridge near Langley Green, and reconstruction of a bridge near Tipton—John Cochrane and Sons, Ltd., Argyle-street, W. 1; (*k*) filling and levelling of a portion of the Corporation allotment ground at Aberystwyth—Messrs. Jones Bros., North Parade, Aberystwyth; (*l*) glazing a new roof at Handsworth and Smethwick Goods Station—W. Edgcumbe, Rendle and Co., Ltd., 5, Victoria-street, S.W. 1; (*m*) adaptation of 407, Oxford-street, London, for a ticket office and inquiry bureau—Samuel Haskins and Brothers, Ltd., Blackhorse-lane, Walthamstow, E. 17; and (*n*) repairs to transit shed and cattle pen accommodation at Waterford—Messrs. John Hearne and Sons, South Parade, Waterford.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

Mr. Andrew Scott asks us to announce that he has closed his offices at 39, Victoria-street, Westminster, and joined the staff of the Woodall-Duckham companies.

Mr. H. P. Lawson, lately a director of Cole, Marchent and Morley, Ltd., Bradford, has been appointed sales manager for Hick, Hargreaves and Co., Ltd., Soho Ironworks, Bolton.

Mr. John W. Hall, M. Inst. C.E., M.I. Mech. E., consulting engineer, of Quality House, 25, Temple-row, Birmingham, informs us that he has been joined in partnership by Mr. Harry Jackson, Assoc. M. Inst. C.E., A.R.S.M., M. Inst. Struct. E., and that in future the firm will practise as Hall and Jackson.

Mr. Basil Johnson was appointed managing director of Rolls-Royce, Ltd., in place of the late Mr. Claude Johnson, at a meeting of the board of directors on April 23rd. Mr. Johnson has been with the company for eleven years, and, as general manager, he was closely associated with the late Mr. Claude Johnson during those years.

LAUNCHES AND TRIAL TRIPS.

Springbank, motor vessel; built by Harland and Wolff, Ltd., to the order of the Bank Line, Ltd.; dimensions, 434ft. by 53ft. 9in. by 37ft.; 5200 gross tonnage. Engines, two sets of Harland-B. and W. six-cylinder four-cycle motors; constructed by the builders; launch, April 13th.

Orestes, motor ship; built by Workman, Clark and Co., Ltd., to the order of Alfred Holt and Co.; dimensions, 476ft. by 58ft. by 35ft. 3in. Engines, twin sets of eight-cylinder Burmeister and Wain four-stroke Diesel; constructed by the builders; launch, April 14th.

Double Cutting Tool-box.—The double cutting tool-box for planing machines is no new thing, and many interesting forms have appeared from time to time. The latest is one which is now being made by C. Redman and Sons, Ltd., of Halifax. It employs a single tool with double cutting edges which is so mounted in the tool-holder that it has a metal-to-metal bearing on both strokes. The box is provided with a tilting motion to enable the tool to be set to the proper cutting position at each end of the stroke. We are informed that the makers' tests of this tool-box have been quite satisfactory and, as one might expect, considerable time is saved by its use.

The Junior Institution of Engineers.—The annual dinner of the Junior Institution of Engineers, which was held at the Monico on Tuesday evening, under the chairmanship of Mr. J. S. Highfield, was the occasion of a number of references to speed of travel, on account, no doubt, of the fact that Sir Sefton Brancker was the first speaker, and it was rather remarkable, in view of the general impression that America is the land of speed, to hear from him that in Detroit a trip in an aeroplane is looked upon as quite an adventure. Mr. A. J. Simpson, who responded to the toast of "The Institution," pointed out the merit of flying as a means of transport on account of the fact that "they drop you just where you want to go"—a remark which caused much amusement. Sir Frank Dyson also had some remarks to make about travel, but they went to show how little was the advance which had been made since early historical days, as Caligula and Peel both took nineteen days to get from Rome to the French shore of the English Channel. Both Mr. Tennant and Mr. Reavell made a plea for the greater appreciation of the commercial side of engineering, the former saying that if he had a million he would found a Chair of Engineering Economics. The toast of "Our Guests" was proposed by Mr. R. L. Kirlew, while that of "The Chairman" was given by Mr. C. E. Atkinson, but there was, as usual, a host of other toasts of an informal character, which were called for by Mr. Tookey with the help of the Institution's spanner.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. Coast—	
Native	18/- to 21/-
(1) Spanish	18/- to 21/-
(1) N. African	18/- to 21/-
N.E. Coast—	
Native	—
Foreign (c.i.f.)	21/3

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) Scotland—		
Hematite	3 17 0	—
No. 1 Foundry	3 19 0 to 4 1 6	
No. 3 Foundry	3 16 6 to 3 19 0	
N.E. Coast—		
Hematite Mixed Nos.	3 16 0	3 16 0
No. 1	3 16 6	3 16 6
Cleveland—		
No. 1	3 13 6	3 14 0
Silicious Iron	3 12 6	3 13 0
No. 3 G.M.B.	3 10 0	3 10 6
No. 4 Foundry	3 9 0	3 9 6
No. 4 Forge	3 8 6	3 9 0
Mottled	3 8 0	3 8 6
White	3 8 0	3 8 6
Mid Lands—		
(3) Staffs.—		
All-mine (Cold Blast)	10 10 0	—
North Staffs. Forge	3 17 6	—
,, ,, Foundry	4 7 6	—
(3) Northampton—		
Foundry No. 3	3 3 0 to 3 4 0	
,, Forge	2 15 0 to 2 16 0	
(3) Derbyshire—		
No. 3 Foundry	3 6 0 to 3 7 0	
Forge	3 0 0 to 3 2 0	
(3) Lincolnshire—		
No. 3 Foundry	3 8 0	—
No. 4 Forge	3 5 6	—
Basic	3 6 0	—
(4) N.W. Coast—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	4 7 6 (a) / 4 10 0 (b) / 4 15 0 (c)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
Scotland—		
Crown Bars	11 5 0	11 0 0
Best	—	—
N.E. Coast—		
Common Bars	11 0 0	—
Lancs.—		
Crown Bars	11 0 0	—
Second Quality Bars	9 15 0	—
Hoops	14 0 0	—
S. Yorks.—		
Crown Bars	12 10 0	—
Best Bars	13 10 0	—
Hoops	14 10 0	—
Midlands—		
Crown Bars	11 0 0 to 11 10 0	
Marked Bars (Staffs.)	14 0 0	—
Nut and Bolt Bars	10 5 0 to 10 10 0	
Gas Tube Strip	12 5 0 to 12 10 0	—

STEEL.

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) Scotland—		
Boiler Plates	11 0 0	—
Ship Plates, ½in. and up	7 12 6	7 0 0
Sections	7 2 6	6 5 0
Steel Sheets, under 3/16in. to ½in.	8 15 0 to 9 5 0	
Sheets (Gal. Cor. 24 B.G.)	—	£15 7 6 to £16 10s.

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. Coast—		
Ship Plates	7 12 6	—
Angles	7 2 6	—
Boiler Plates	11 10 0	—
Joists	7 2 6	—
Heavy Rails	8 0 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5
Hard Billets	8 2 6	—
Soft Billets	7 5 0	—
N.W. Coast—		
Barrow—		
Heavy Rails	8 0 0†	—
Light Rails	8 5 0 to 8 10 0	
Billets	7 10 0 to 9 0 0†	
Manchester—		
Bars (Round)	8 0 0 to 8 5 0	
,, (others)	8 0 0 to 8 5 0	
Hoops (Best)	13 5 0	13 0 0
,, (Soft Steel)	10 0 0	9 15 0
Plates	7 17 6	—
,, (Lancs. Boiler)	11 10 0	—
Sheffield—		
Siemens Acid Billets	10 10 0	—
Bessemer Billets	11 5 0	—
Hard Basic	8 12 6	—
Intermediate Basic	8 2 6	—
Soft Basic	6 15 0	—
Hoops	12 0 0	—
Soft Wire Rods	9 10 0	—
Midlands—		
Small Rolled Bars	7 15 0 to 8 0 0	
Billets and Sheet Bars	6 2 6	—
Sheets (20 W.G.)	11 10 0 to 12 0 0	
Galv. Sheets, f.o.b. L'pool	15 5 0 to 15 10 0	
Angles	7 2 6	—
Joists	7 2 6	—
Tees	8 2 6	—
Bridge and Tank Plates	7 17 6	—
Boiler Plates	11 0 0 to 11 10 0	

NON-FERROUS METALS.

Swansea—	
Tin-plates, I.C., 20 by 14	19/- to 19/6
Block Tin (cash)	279 0 0
,, (three months)	269 15 0
Copper (cash)	57 5 0
,, (three months)	58 2 6
Spanish Lead (cash)	28 12 6
,, (three months)	29 2 6
Spelter (cash)	32 11 3
,, (three months)	32 16 3
Manchester—	
Copper, Best Selected Ingots	62 2 6
,, Electrolytic	65 17 6
,, Strong Sheets	90 0 0
,, Tubes (Basis Price)	0 1 0½
Brass Tubes (Basis Price)	0 0 11½
,, Condenser	0 1 2
Lead, English	30 10 0
,, Foreign	29 12 6
Spelter	33 5 0

FERRO ALLOYS.

(All prices now nominal.)

	Per Ton.	Per Unit.
Tungsten Metal Powder	2/- per lb.	
Ferro Tungsten	1/9d. per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£22 10 0	7/6
,, 6 p.c. to 8 p.c. ,,	£22 0 0	7/3
,, 8 p.c. to 10 p.c. ,,	£20 15 0	6/6
,, Specially Refined		
,, Max. 2 p.c. carbon	£38 10 0	12/6
,, ,, 1 p.c. ,,	£44 10 0	15/-
,, ,, 0·70 p.c. carbon	£54 10 0	17/6
,, ,, carbon free	1/5½d. per lb.	
Metallic Chromium	3/3 per lb.	
Ferro Manganese (per ton)	£15 for home, £15 for export	
,, Silicon, 45 p.c. to 50 p.c.	£11 15 0 scale 5/- per unit	
,, ,, 75 p.c.	£20 10 0 scale 6/- per unit	
,, Vanadium	14/6 per lb.	
,, Molybdenum	6/- per lb.	
,, Titanium (carbon free)	0/11 per lb.	
Nickel (per ton)	£170	
Cobalt	10/- per lb.	
Aluminium (per ton)	£112	

FUELS.

SCOTLAND.

	Export.
Lanarkshire—	
(f.o.b. Glasgow)—Steam	15/9
,, ,, Ell	16/6
,, ,, Splint	16/6 to 17/-
,, ,, Trebles	15/9
,, ,, Doubles	14/- to 14/6
,, ,, Singles	13/9
Ayrshire—	
(f.o.b. Ports)—Steam	16/9
,, ,, Jewel	17/- to 17/6
,, ,, Trebles	17/-
Fifeshire—	
(f.o.b. Methil or Burntisland)—Steam	12/6 to 14/9
Screened Navigation	21/-
Trebles	14/- to 15/-
Doubles	14/-
Singles	13/- to 13/6
Lothians	
(f.o.b. Leith)—Best Steam	14/- to 14/3
Secondary Steam	13/6
Trebles	14/6 to 14/9
Doubles	13/6
Singles	13/6

ENGLAND.

	Inland.	Export.
(8) N.W. Coast—		
Steams		23/-
Household		40/- to 48/-
Coke		24/-
Northumberland—		
Best Steams		16/-
Second Steams		14/6 to 15/-
Steam Smalls		8/- to 8/6
Unscreened		13/- to 13/6
Household		20/- to 22/-
Durham—		
Best Gas		18/6 to 19/-
Second		15/- to 15/6
Household		20/- to 22/-
Foundry Coke		18/- to 20/-
Sheffield	Inland.	
Best Hand-picked Branch	31/- to 34/-	—
Barnsley Best Silkstone	28/- to 30/-	—
Derbyshire Best Brights	26/- to 28/-	—
,, ,, House	24/- to 25/-	—
,, ,, Large Nuts	17/- to 20/-	—
,, ,, Small	12/6 to 14/-	—
Yorkshire Hards	17/- to 19/6	—
Derbyshire Hards	16/- to 19/-	—
Rough Slacks	10/- to 12/6	—
Nutty Slacks	7/6 to 9/-	—
Smalls	3/6 to 6/-	—
Blast-furnace Coke (Inland)*	—	—
,, ,, (Export)	f.o.b.	16/- to 17/-

(9) SOUTH WALES.

Cardiff—	
Steam Coals:	
Best Smokeless Large	26/- to 27/-
Second ,, ,,	24/6 to 25/6
Best Dry Large	24/- to 25/-
Ordinary Dry Large	21/- to 22/-
Best Black Vein Large	25/6 to 26/-
Western Valley Large	24/6 to 25/-
Best Eastern Valley Large	24/- to 25/-
Ordinary ,, ,,	23/6 to 24/-
Best Steam Smalls	17/- to 18/-
Ordinary ,,	16/- to 17/-
Washed Nuts	19/- to 26/-
No. 3 Rhondda Large	26/6 to 27/-
,, ,, Smalls	18/- to 18/6
No. 2 ,, Large	24/- to 25/-
,, ,, Through	20/- to 21/-
,, ,, Smalls	15/- to 16/-
Foundry Coke (export)	40/- to 50/-
Furnace Coke (export)	25/- to 30/-
Patent Fuel	22/- to 24/-
Pitwood (ex ship)	26/- to 26/6
Swansea—	
Anthracite Coals:	
Best Big Vein Large	39/- to 40/-
Seconds	32/6 to 35/-
Red Vein	27/- to 29/-
Machine-made Cobbles	47/6 to 50/-
Nuts	47/6 to 50/-
Beans	42/6 to 44/-
Peas	23/- to 25/-
Breaker Duff	7/6 to 8/-
Rubbly Culm	12/6 to 13/6
Steam Coals:	
Large	22/6 to 24/6
Seconds	20/- to 22/-
Smalls	11/- to 15/-
Cargo Through	16/6 to 17/6

(1) Delivered. (2) Net Makers' works. (3) f.o.t. Makers' works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayreshire.

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/- extra delivered England. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. * For blast-furnaces only, 17/-, with fluctuations according to analysis; open market 17/6 to 19/- at ovens. † Latest quotations available. (a) Delivered Glasgow. (b) Delivered Sheffield. (c) Delivered Birmingham.

French Engineering Notes.

(From our Correspondent in Paris.)

The Situation.

THE only factor that influences business is the desire of consumers to buy on a rising market. Under normal conditions that factor would encourage a general activity, but at present it merely creates an irregular demand which insures employment to some firms while others are almost destitute of work. There are some engineering companies which are quite satisfied with the volume of business transacted. Others are slowing down and running short time. It is even affirmed that one big concern in the Paris district specialising in locomotives, bridgework and the like, and another in the Nord, which turns out mainly heavy steel plate pressing work, will soon close down unless an improvement takes place in the meanwhile. The chances of such an improvement do not appear encouraging in view of the steadily increasing cost of living due to the continued depreciation of the franc, for wages necessarily follow the movement, and at the moment there is certainly a great deal of unrest amongst workers, who are drifting into an agitation for higher wages. The only thing that deters them at present is the precarious situation of manufacturers, who find production costs increasing so rapidly that they experience great difficulty in selling at profitable prices, and it is probable that if a demand were made for increased wages, they would have to consider very seriously the possibility of being able to continue to work under present conditions. The higher import duties have had the immediate effect of putting up prices, beginning with raw materials and imported commodities, and, with the continued devalorisation of the franc, it is feared that selling prices have already reached a point very near the limit of the purchasing capacity of consumers. There are, nevertheless, certain industries which are fairly prosperous, notably electrical engineering, which is benefiting from electrical enterprise all over the country, and in view of what has still to be done with the national electrification scheme, the future is promising. Makers of agricultural machinery also have never been so busy as they are now.

Narrow-gauge Railways.

Long before there could be any question of replacing the narrow gauge railway with cheaper and more convenient forms of transport, many rural districts in this country were well equipped with what were called "chemins de fer économiques." These light railways, usually laid by the roadside, undoubtedly rendered good service at a time when there was no other means of transport, and they were even supposed to be indispensable for the economical development of the country. The railways, however, were far from justifying the name attached to them, for being unable to pay their way many were abandoned, and now that the motor lorry and omnibus have penetrated into the remotest districts, it is suggested that the light railways should be suppressed altogether. This has brought a reply from one of the companies which affirms that the light railway is not moribund, that it is capable of more than holding its own with motor traction, and that it has the further advantage of not destroying the roads, as is alleged to be the case with heavy motor vehicles. It is explained that light railways could pay their way if the companies were allowed to increase fares and rates in the same way as is being done on the big railway systems. Economies may also be effected by replacing steam locomotives with petrol motors. In a word, the companies running light railways are not disposed to abandon them in face of the growing road motor competition, and believe even that a new lease of life can be given to the railways by adapting them to modern conditions.

Railway Progress.

Unless the trade situation should take a decidedly unfavourable turn detrimental to railway traffic, it seems probable that most of the railway companies will be able to wipe out their annual deficits by 1927, when the State will definitely withdraw its guarantee. According to the report of the P.L.M. Company the deficit, which amounted to 253 million francs in 1922 and was reduced to 53 million francs in 1924, fell, in 1925, to 5,500,000 f. As the working expenses were much higher the reduction of the deficit was due entirely to a considerable increase in traffic. The greatest improvement was in goods traffic, which corresponded with a general industrial activity, and it remains to be seen whether, with the present slackening of business, the improvement will be maintained. Since the rates were increased at the beginning of the year, there has been a further augmentation of traffic receipts and, apparently encouraged by this success, the authorities have decided to put them up another 6 per cent. next month At the same time the railway companies have sent large sums of money in perfecting their equipment for dealing with the traffic. More has certainly been done during the past four years than in any similar period.

The Rhine-Rhone Canal.

The failure of the State to participate financially in public works is responsible for the holding up of nearly all the big inland waterway undertakings. A considerable amount of money has already been spent upon the canal between the Rhine and Rhone, with the idea of permitting 300 tons barges to navigate between Lyons and Strasburg. As the State is unable to contribute its share, the work is practically suspended. Its completion will necessitate an expenditure of between seven and eight million francs, the greater part being required for the construction of a reservoir at Valdieu, which will be fed by five small rivers. As nothing can obviously be expected from the State, the fifteen Chambers of Commerce and eight Conseils Généraux interested in the success of the undertaking were represented at a meeting held recently at Mulhouse, when it was decided to raise the money to complete the canal improvements. As soon as the various bodies interested agree to the extent of their participation, powers will be applied for to raise the money for the completion of a canal which will be a continuation of the Rhone and will eventually provide an uninterrupted waterway between Alsace and Marseilles.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

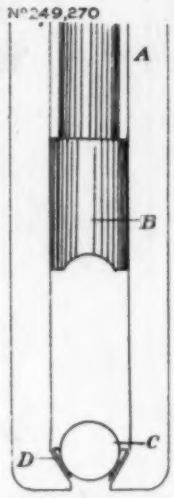
Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

INTERNAL COMBUSTION ENGINES.

249,270. February 2nd, 1925.—IGNITION OF EXPLOSIVE MIXTURES, O. S. Wolstenholme, Fouad 1, Government School, Abbasia, Cairo, Egypt.

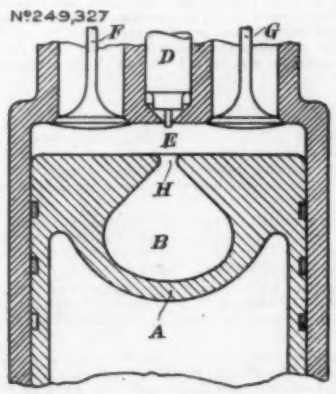
The inventor proposes to ignite the explosive charge of an internal combustion engine by the sudden compression of a part



of the charge. The compression is effected in a tube A of fused silica or quartz by means of a plunger B. The open end of the tube is closed by a ball C and minute passages D are provided for the escape of the compressed charge into the combustion chamber.—*March 25th*, 1926.

249,327. April 3rd, 1925.—COMBUSTION CHAMBERS, *R. Haddan*, 31, *Bedford-street, Strand, London, W.C.* 2.

In this engine a cavity B is formed in the piston. It communicates by means of a narrow passage H with the combustion chamber E. During the compression stroke air, which has been admitted by the valve F, is compressed, and a stream of highly compressed air is forced through the passage H into the cavity.

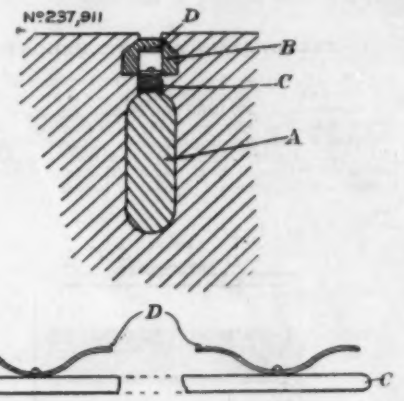


During the latter part of the stroke fuel is injected past the valve D, and as there is no unrestricted passage into the cavity, some mixing of fuel with hot air occurs before the fuel enters the cavity. Consequently a mixture of fuel and air is forced into the cavity, where the mixture is completed, by addition of air, and ignition takes place, the ignition being propagated into the chamber E. The products of combustion are exhausted through the port controlled by the valve G.—*March 25th*, 1926.

DYNAMOS AND MOTORS.

237,911. July 29th, 1925.—IMPROVEMENTS IN AND RELATING TO DYNAMO-ELECTRIC MACHINES, *International General Electric Company, Incorporated, of* 120, *Broadway, New York.*

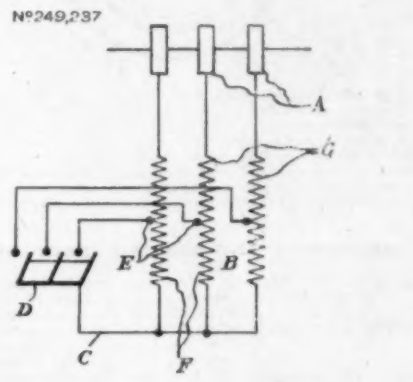
This specification describes an asynchronous self-starting motor. The leakage conditions of the rotor alter with the number of revolutions, so that, in starting, the motor shows similar leakage conditions to machines built on the Boucherot principle, while in normal running the leakage conditions of the ordinary asynchronous motor are obtained. The rotor has a working winding A of slight resistance and a starting winding B on the slot head of high resistance. Both windings may be constructed with a common or separate short-circuiting ring. The slot base and the slot head, in which the windings A and B are respectively placed, are connected by a slit in which a magnetically conducting body C, for example, an iron bar, is movably arranged. This bar may be constructed as shown in the lower illustration. In starting, the bar is pressed against the winding A by one or more plate springs D so that the conductivity for the stray lines, which enclose the winding A, is increased. With an increasing number of revolutions the bar is pressed outwards by the centrifugal force acting upon it. The bar is enabled by means of the U-shaped construction of the starting winding B to slide into the latter. In this way the resistance for the leakage lines of the working winding is considerably increased, and the power factor becomes approximately the same as that for the motor free from current displacement. Owing to the slight leakage between the two windings A and B the starting winding in normal



working is almost entirely without current, and, as compared with current-displacement machines of the usual type, the efficiency is increased.—*March 25th*, 1926.

249,237. December 30th, 1924.—IMPROVEMENTS IN AND RELATING TO DYNAMO-ELECTRIC MACHINES, The British Thomson-Houston Company, Ltd., of Crown House, Aldwych, London, W.C. 2, and Frank Percy Whitaker, of 237, Clifton-road, Rugby.

This invention relates to dynamo-electric machines of the kind known as self-synchronising motor converters. The slip rings A of the induction motor rotor are shown connected in series with the resistance sections B. These sections are connected by

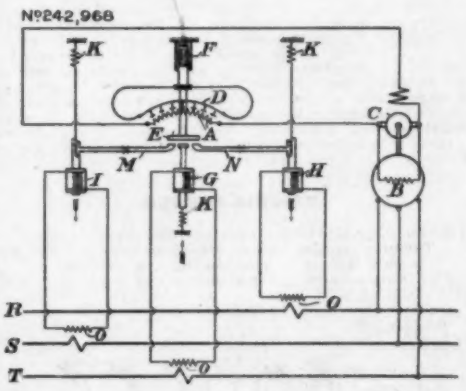


the lead C to the polyphase switch D, from which leads are taken to suitable points E on the resistance sections. When the machine is first being started the switch D is closed, thus short-circuiting the lower portions F of the resistance sections and leaving only the upper portions G in circuit with the slip rings. When the rotor has reached a predetermined speed the switch D is opened, thus connecting in the whole of resistance sections D and thereby reducing the starting torque owing to current passing through the resistance.—*March 25th*, 1926.

SWITCHGEAR.

242,968. October 28th, 1925.—IMPROVEMENTS IN PROTECTIVE DEVICES FOR USE IN POLYPHASE CURRENT INSTALLATIONS, Aktiengesellschaft Brown, Boveri et Cie., Baden, Switzerland.

This invention has reference to protective devices for use in polyphase current installations designed to become operative when an overload occurs on one or more of the phases. In the diagram A is a resistance inserted in the field circuit of the exciter C of the polyphase generator B. This resistance is controlled by a member D which normally occupies a position in which the resistance A is short-circuited. The member D is held in this position by a spring F. The member D



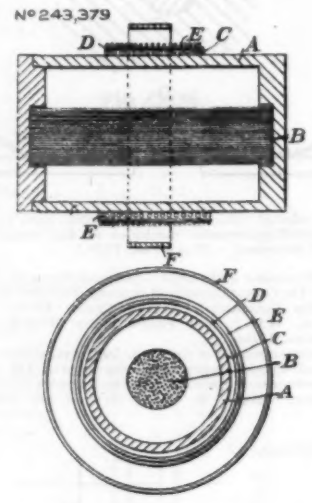
carries a plate E which occupies a position opposite to an electro-magnet G, and the ends of two two-armed levers M N. The levers M N are connected with and operated by the armature of electro-magnets H I respectively. K K K are adjustable tension springs which act on the armatures of the electro-magnets G H I and oppose their movement. Each of the windings of the electro-magnets G H I is connected through an independent current transformer O with one of the leads R S T. If an overload occurs in one of the phases, say, in phase S, the electro-magnet I is energised to actuate the lever M which strikes and raises the plate E and with it the member D. The short circuit on the resistance A is removed, wholly or partly, the exciting current is reduced and the potential of the generator

B falls. In the case of an overload of equal amount in two or all the phases the electro-magnets energised by the phases are caused to operate the member D. In order to minimise the energy necessary for operation of the member B the spring F is made as weak as possible.—*March 25th*, 1926.

TELEGRAPHS AND TELEPHONES.

243,379. November 20th, 1925.—Improvements in High-frequency Transformers, Société Française Radio-Electrique, of 79, Boulevard Haussmann, Paris, France.

The wave length range of the high-frequency transformer described in this specification may be adjusted after manufacture and it may be efficiently employed in apparatus comprising several amplification stages. The transformer comprises a cylindrical support A composed of insulating material, such

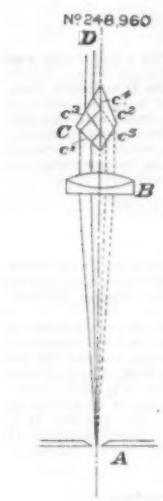


as ebonite, closed at both ends by cheeks and surrounding the magnetic core B, which is composed, for example, of a bundle of small soft iron wires. A winding C is wound upon the cylinder A, preferably in a single layer, and is covered with a sheet of insulating material D, upon which the second winding E is wound. F is an outer conducting ring, surrounding the second winding and arranged so that it may be moved longitudinally relative to the core for adjustment purposes.—*March 18th*, 1926.

MEASURING AND TESTING INSTRUMENTS.

248,960. May 8th, 1925.—Spectroscopes, C. J. Beck, Lister Works, Dickenson-street, Kentish Town, N.W. 5, and R. and J. Beck, Ltd., 68, Cornhill, London, E.C. 3.

This instrument is intended for the ready determination of the position of a line or band in the spectrum. In it a slit A is placed in the focal plane of a collimating lens B, and a compound prism C is placed behind this lens, the eye being placed at D for observation. The surface C^1 is coated with a diffraction grating of which the grating may consist of lines ruled upon this surface. Direct light—not diffracted—is refracted by surface C^3, reflected to the left by surface C^4 and then is refracted by surface C^2 in such a way that an eye placed at D does not see it. The bundle of the first order diffracted from the grating is reflected by the surface C^4, which is partly silvered over its entire area, in such a direction that on subsequent refraction by the surface C^2 the mean angular direction of the spectral bundles is partial to the axis of the instrument. A portion of the light, however, from the collimating lens B passes into the compound prism through the surface C^5, which is parallel to C^2, then passes through the semi-silvered surface C^4 and emerges after refraction at surface C^2 in a direction parallel to its original direction and superimposed upon the bundles that entered the prism through surface C^1, so that an eye placed at D sees the spectrum with an image of the slit A superimposed upon it at the same time. If the compound prism is tilted on an axis parallel with the slit A and at right angles to the axis, the spectrum is moved in a direction parallel to its length and the slit image remains stationary. If the motion is imparted by a screw acting at right angles to the axis, a motion is produced in which the travel of the screw is proportional to the sine of the angular movement produced. By this means, an approximate scale of wave lengths can be made by dividing a drum attached to the screw.—*March 18th*, 1926.



MISCELLANEOUS.

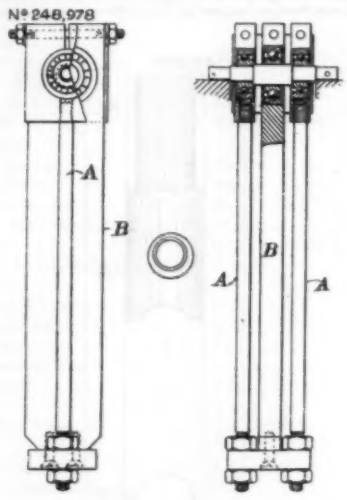
249,318. March 19th, 1925.—Improvements relating to Thermo-electric Cells, *Metropolitan-Vickers Electrical Company, Ltd., of 4, Central-buildings, Westminster.*

The thermo-electric cell described in this specification com-

prises a base A generally in the form of a flat plate of insulating material, such as asbestos, upon the surface or surfaces of which there is a series of strips B and C of metal of different kinds having junctions at or near to the edges of the plate. To provide such a structure the surface D of the base may first be covered with a sheet of material having openings corresponding to the strips B, and a suitable metal, such as copper, is sprayed on the surface, after which the pattern is removed and another pattern corresponding to strips C of a different metal, such as zinc, is applied. The second metal is then sprayed on. Any suitable method, such as the Schoop metal spraying process, may be utilised for spraying the metals. Terminals E are provided by spraying a suitable portion along the ends of the plate. A thermo-electric element is thus produced consisting of a series of junctions along the top and bottom edges F of the insulating plate. A suitable number of such plates are assembled on edge in a container having a nichrome resistance element in the bottom, the upper edges of the plates being exposed to the atmosphere.—*March 25th*, 1926.

248,978. June 18th, 1925.—Thermostatic Apparatus, *J. W. Kirkland, Crown House, Aldwych, London.*

It is suggested in this specification that the use of metallic thermostats for the control of switches is often very inconvenient on account of their small range of movement, regardless of the large forces available. In the apparatus, the rods of different



expansion coefficients A A and B are connected together at the bottom and at the top have ball bearings embracing a spindle. The spindle is excentric for the centre bearing, and the natural result is that expansion of the rods produces an angular movement of the spindle, the extent of which is dependent on the amount of the excentricity.—*March 18th*, 1926.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME and PLACE at which the meeting is to be held should be clearly stated.

TO-DAY.

Institution of Civil Engineers: Birmingham and District Association.—Chamber of Commerce, New-street, Birmingham. Annual general meeting. Paper, "Notes on a Recent Visit to Canada and the United States of America," by Mr. A. W. Willett. 6 p.m.

Institution of Electrical Engineers: Scottish Centre.—Y.M.C.A. Hall, Constitution-road, Dundee. Lecture, "The Past, Present and Future Development of Wireless Telephony," by Captain P. P. Eckersley. 7.30 p.m.

Institution of Mechanical Engineers.—Storey's-gate, Westminster, London, S.W. 1. Informal meeting. Discussion, "Marine Oil Engines in Practice," introduced by Mr. C. W. J. Taffs. 7 p.m.

Junior Institution of Engineers.—Royal United Service Institution, Whitehall, London, S.W. 1. Gustave Canet Memorial Lecture, "Air Transport," by Air Vice-Marshal Sir W. Sefton Brancker. 7.30 p.m.

Royal Institution of Great Britain.—21, Albemarle-street, London, W. 1. Discourse, "Wireless in the Empire," by Dr. W. H. Eccles. 9 p.m.

SATURDAY, MAY 1st.

Institute of British Foundrymen: Lancashire Branch.—College of Technology, Sackville-street, Manchester. Paper, "Refractories in the Foundry," by Messrs. H. V. Grundy and A. Phillips. 4 p.m.

Institution of Municipal and County Engineers.—South-Eastern District meeting at Margate. 11 a.m.

Royal Institution of Great Britain.—21, Albemarle-street, London, W. 1. Annual meeting. 5 p.m.

MONDAY, MAY 3rd.

Institution of Electrical Engineers: Western Centre. Chamber of Commerce, Cambrian-place, Swansea. Paper, "The All-electric House," by Professor S. Parker Smith. 6 p.m.

Royal Institution of Great Britain.—21, Albemarle-street, London, W. 1. General meeting. 5 p.m.

Society of Engineers.—The Science Museum, South Kensington, London, S.W. 7. Paper, "Landmarks in the History of Prime Movers," by Mr. H. W. Dickinson. 5.30 p.m.

TUESDAY, MAY 4th.

Institute of Marine Engineers.—85–88, The Minories, Tower Hill, London, E. 1. Paper, "Steam Pipes for Super High Pressure," by Mr. J. A. Aiton. 6.30 p.m.

WEDNESDAY, MAY 5th.

Electrical Association for Women.—Lesser Free Trade Hall, Manchester. Public meeting in connection with the Manchester District Branch. 7.30 p.m.

Institution of Electrical Engineers.—Savoy-place, Victoria Embankment, London, W.C. 2. Wireless Section meeting. Paper, "On the Cause and Elimination of Night Errors in Radio Direction Finding," by Dr. R. L. Smith-Rose and Mr. R. H. Barfield. 6 p.m.

Royal Society of Arts.—John-street, Adelphi, London, W.C. 2. "Radio: Its Past, Present and Future," by Mr. C. F. Elwell. 8 p.m.

THURSDAY, MAY 6th.

Institution of Automobile Engineers.—Cavendish Café, Cornmarket, Derby. Derby Graduates' meeting. Paper. "Inspection in the Building of an Automobile Chassis," by Mr. J. Topham. 7.30 p.m.

Royal Institution of Great Britain.—21, Albemarle-street, London, W. 1. "The Imperfect Crystallisation of Common Things," by Sir William Bragg. 5.15 p.m.

THURSDAY AND FRIDAY, MAY 6th and 7th.

Iron and Steel Institute.—Institution of Civil Engineers, Great George-street, London, S.W. 1. Annual meeting. For programme see page 447. 10 a.m. each day.

FRIDAY, MAY 7th.

Chemical Engineering Group.—Florence Restaurant, 56, Rupert-street, London, W. 1. Annual general meeting and informal dinner. 6.30 p.m.

Electrical Association for Women.—Criterion Restaurant, Piccadilly, London, W. 1. Luncheon. 1 p.m.

Institution of Mechanical Engineers.—Storey's-gate, Westminster, London, S.W. 1. Fourth Report of Marine Oil Engine Trials Committee. 6 p.m.

Institution of Municipal and County Engineers.—Yorkshire District meeting at Wakefield. 11 a.m.

Junior Institution of Engineers.—39, Victoria-street, London, S.W. 1. Lecturette, "Distortion in Wireless Reception," by Mr. A. V. Ballhatchet. 7.30 p.m.

Royal Institution of Great Britain.—21, Albemarle-street, London, W. 1. "English Illuminated Manuscripts," by Sir F. G. Kenyon. 9 p.m.

TUESDAY, MAY 11th.

Institute of Physics.—Physics Theatre, Royal College of Science, South Kensington, London, S.W. 7. Public lecture, "The Relationship of Physics to Aeronautical Research," by Mr. H. E. Wimperis. 5.30 p.m.

WEDNESDAY, MAY 12th.

Royal Society of Arts.—John-street, Adelphi, London, W.C. 2. "Industrial Welfare in Practice," by Mr. W. S. Bradley. 8 p.m.

THURSDAY, MAY 13th.

Faraday Society.—Institution of Mechanical Engineers, Storey's-gate, Westminster, London, S.W. 1. General discussion on "Explosive Reactions in Gaseous Media." 2.30 p.m.

Institution of Locomotive Engineers: Manchester Centre.—Visit to the locomotive works of the L.M.S. Railway at Crewe. 2 p.m.

THURSDAY TO SATURDAY, MAY 13th to 15th.

Institute of Transport.—Sixth Congress at Birmingham. For programme see page 468.

FRIDAY, MAY 14th.

Institution of Municipal and County Engineers.—North-Western District meeting at Blackburn. 10.45 a.m.

Railway Club.—65, Belgrave-road, London, S.W. 1. Paper, "Some Observations on Modern Locomotive Practice," by Mr B. M. Bazley. 7.30 p.m.

WEDNESDAY, MAY 19th.

Institute of Metals.—Institution of Mechanical Engineers, Storey's-gate, London, S.W. 1. Annual May Lecture, "Single Metallic Crystals and their Properties," by Professor H. C. H. Carpenter. 8 p.m.

Busk Studentship in Aeronautics.—A vacancy for the Busk Studentship in Aeronautics for 1926–7 exists, and the following particulars may therefore be of interest. This studentship was established in memory of Edward Teshmaker Busk, who in 1914 lost his life while flying an experimental aeroplane. It is of the value of about £150, tenable for one year from October 1st; but a student may be reappointed on the same terms for a second year. It is open to any man or woman being a British subject and of British descent who has not attained the age of twenty-five years on October 1st next. The object of the studentship is to enable the holder to engage in research, or preparation for research in aeronautics and specially in those subjects such as stability problems, meteorological questions bearing on flight, or the investigation of gusts, treated either experimentally or mathematically in which Edward Busk was specially interested. The student will be expected to devote his whole time to research on a subject approved by the trustees, and at the close of his studentship to make to them and to the University of Cambridge a report on his work; he may also be asked to deliver a lecture on the subject. He may not undertake other duties without the express consent of the trustees. The tenure of the studentship will depend on compliance with these conditions. Subject to the permission of the trustees the student may carry out his research either at home or abroad. Forms of application for the studentship can be obtained from Professor B. Melvill Jones, Engineering Laboratory, Cambridge, and must be filled up and returned to him not later than May 12th next.

Veteran Workers at Ironworks and Collieries.—A short time ago the *Nottingham Evening News* invited manufacturers and industrialists in the Midlands to submit to it for publication the names of their workers who had been in their continuous employ for a period of forty years and over. The Stanton Ironworks Company, Ltd., near Nottingham, employs some 14,000 workpeople, and was able to submit the names of 265 veterans who are still in its employ and who have served it for a minimum period of forty years. The maximum period of service of any employee was sixty-two years, and no small number fell within the range of forty-five and fifty-five years' service. The number submitted by the Stanton Company of 265 individual cases was, we understand, by far the largest number submitted by any single firm of employers. The *Nottingham Evening News* subsequently issued a printed certificate for each of the names included in the list, and during the past few weeks Mr. E. J. Fox, the managing director of the Stanton Company, has been presenting these certificates at the company's various centres. The number of veterans at the Stanton works totalled 86, at the Pleasley Colliery 59, at the Oakes (Riddings) Works 43, at the Holwell Works 41, and at the Teversal and Silverhill Collieries 36. At each of the centres the men were entertained to dinner in company with the members of the Employees' Works and Welfare Committee. Mr. Fox, in presenting the certificates, said that he hoped that the younger generation would follow the good example set by their elders and settle down to honest hard work, a life which had obviously been led by those to whom certificates were being presented.